New Scientist

ARE ARTIFICIAL SWEETENERS BAD FOR US?

STUNNING NEW JWST IMAGE

UNCOVERING THE GENETICS OF DYSLEXIA

SUPER-ACCURATE QUANTUM STOPWATCH

WEEKLY 29 October 2022

CLIMATE ACTION: A PROGRESS REPORT

Ahead of the COP27 summit, what hope do we have of hitting the crucial targets?

OCEAN WORLDS

The search for exoplanets covered in water

PLUS CHATTY REPTILES / WHO IS THE MOST AVERAGE PERSON? / STRETCHY PROTONS / **HOW TO SWEETEN YOUR SWEET POTATOES**

No3410 £6.95 CAN$9.99

abrdn

To aim for a steadier income, we blend a broader portfolio.

Aberdeen Diversified Income and Growth Trust

We know how important a reliable income is for many investors. So we've blended a portfolio that aims to achieve just that.

From emerging market bonds to private equity funds, aircraft leasing to real estate, Aberdeen Diversified Income and Growth brings together an exceptional range of investments – including many that investors would find hard to access directly.

All aiming to deliver strong and dependable income – plus long-term capital growth potential too.

Please remember, the value of shares and the income from them can go down as well as up and you may get back less than the amount invested.

Request a brochure: 0808 500 4000

aberdeendiversified.co.uk

Issued by Aberdeen Asset Managers Limited, registered in Scotland (SC108419) at 10 Queen's Terrace, Aberdeen, AB10 1XL, authorised and regulated in the UK by the Financial Conduct Authority. Please quote 2953.

This week's issue

On the cover

38 Climate action: A progress report
Ahead of the COP27 summit, what hope do we have of hitting the crucial targets?

46 Ocean worlds
The search for exoplanets covered in water

New Scientist

CLIMATE ACTION: A PROGRESS REPORT

Vol 256 No 3410
Cover image: Andrea Ucini

43 Are artificial sweeteners bad for us?

14 Stunning new JWST image

19 Uncovering the genetics of dyslexia

9 Super-accurate quantum stopwatch

12 Chatty reptiles
54 Who is the most average person?
23 Stretchy protons
51 How to sweeten your sweet potatoes

38 Features

> “Renewables are now by far the cheapest energy source almost everywhere”

News

11 Turmeric trouble
Spice supplements linked to liver damage

16 Underfloor heating
Can geothermal energy end the UK's reliance on gas?

20 Diplomacy skills
AIs beat humans at first world war strategy game

Views

27 Comment
The Red Planet spells adventure, says Stuart Clark

28 The columnist
Chanda Prescod-Weinstein on James Webb's legacy

30 Aperture
Researchers unveil the world's largest digital camera

32 Letters
Condolences and thoughts on green funerals

34 Culture
The Blaze reveals the turmoil and tragedy of wildfires

HANNIBAL HANSCHKE/REUTERS/ALAMY

8 Melting away The grand plan to save a gigantic Greenland glacier

Features

38 Last shot
After years of missed opportunities to hit climate goals, there is still room for optimism

43 Sweet nothings
We are learning about the potential dietary effects of artificial sweeteners

46 Water, water everywhere
Planets flush with water could be common. Can we find one?

The back pages

51 The science of cooking
Sweetening sweet potatoes

53 Puzzles
Try our crossword, quick quiz and logic puzzle

54 *Almost* the last word
What would the most average person in the world be like?

56 Feedback
Holy nitpicking and quantum spirituality: the week in weird

56 Twisteddoodles for *New Scientist*
Picturing the lighter side of life

Elsewhere on New Scientist

Virtual event

Memory, the brain and who we are

How do our brains store past experiences to make us who we are? Why can memories feel so real? Are there such things as "true" and "false" memories? Psychiatrist Veronica O'Keane offers a new way of thinking about our personal experiences. Watch online at 6pm GMT/ 1pm EST on 10 November. Also available on demand.

newscientist.com/events

Tour

Norway: Wonders of the Arctic

Explore Norway's beautiful fjords, view the Northern Lights, glimpse whales and polar bears and discover the frozen Svalbard archipelago. Led by *New Scientist* podcast editor Rowan Hooper, this nine-day tour begins on 2 March 2023 and includes two marine safaris, a dog sled journey that will take you to explore under a glacier, and a plethora of Arctic science. The price is £5549.

newscientist.com/tours

Podcast

Weekly

Podcast editor Rowan Hooper talks to John Moore and Ilona Mettiäinen, both at the University of Lapland in Finland, about using precision geoengineering to help slow the rate of ice loss from Greenland. There is also news that female European robins sing just as well as their male counterparts. Plus, the team discusses insights into Neanderthal family dynamics.

newscientist.com/nspod

ALEXRATHS/GETTY IMAGES

Secret history When did we start growing squashes?

SHUTTERSTOCK/PIOTR KRZESLAK

Arctic adventure There is plenty to see on a trip to Norway

Video

Prizewinning photos

You can take a look at some of the winning images from the Wildlife Photographer of the Year 2022 competition over on our YouTube channel. There is also a chance to hear from three of the winners, who tell the stories behind their images – including a photograph of bees hunting for a mate and an extraordinary image of a Leach's sea star in the act of spawning.

youtube.com/newscientist

Newsletter

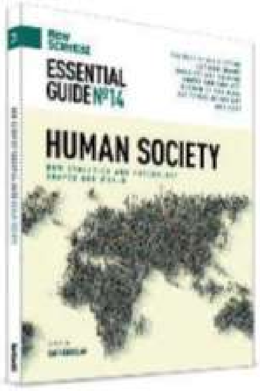
Wild Wild Life

Before humans began eating pumpkins – or carving them – North American mammals, such as the mastodon, dined on ancient versions of the squash, says *New Scientist*'s news and digital director Penny Sarchet. Domestication of the squash began 11,000 years ago. Now, the plants are grown globally.

newscientist.com/ wild-wild-life

Podcast

> **"There are people who are horrified by the thought of interfering in such complex systems"**



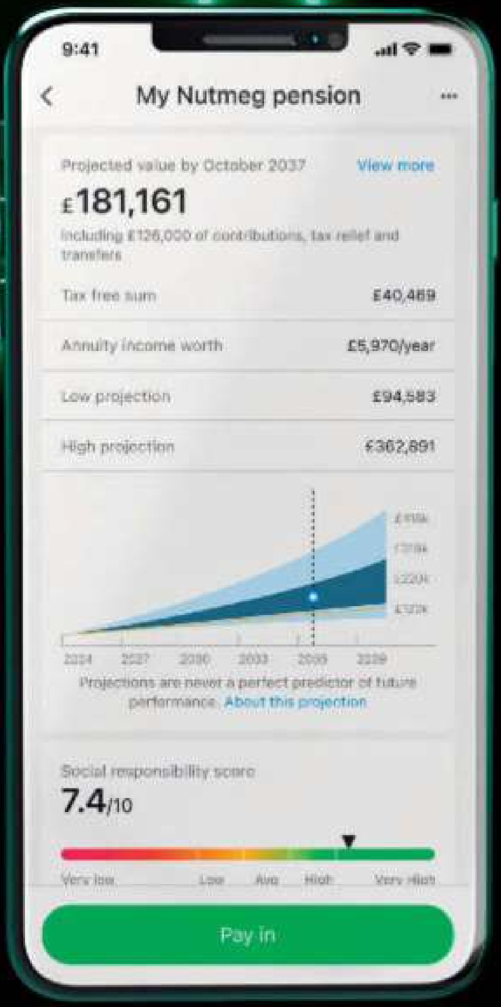
Essential guide

How did evolution and psychology shape human society? We differ from most other animals in that we cooperate with strangers as well as with family members. Learn about how this happened – and the tensions it has created – in the latest *New Scientist Essential Guide*. Available to purchase now.

shop.newscientist.com

THE NEW
i7
FORWARDISM
EVERY MOVEMENT CREATES ITS OWN ICON.
#bornelectric
BMW
M.DM 8647E

Nutmeg.
a J.P.Morgan company



9:41

My Nutmeg pension

Projected value by October 2037 View more

£181,161

Including £126,000 of contributions, tax relief and transfers

Tax free sum	£40,469
Annuity income worth	£5,970/year
Low projection	£94,583
High projection	£362,891

Projections are never a perfect predictor of future performance. About this projection

Social responsibility score

7.4/10

£100 reward when you transfer a pension to us

Step into the pension glow.

Transfer your pension to see exactly where it's invested, and track its performance with our charts and tools.

Capital at risk. Tax treatment depends on your individual circumstances and may change in the future.

Check before you transfer. Past performance and forecasts are not reliable indicators of future performance. T&Cs apply. Transfer by 31st December 2022. Min transfer £1,000.

Open an account and transfer today.

Download on the App Store

GET IT ON Google Play

Could do better

Reasons for concern, and optimism, ahead of the next crucial climate summit

ON 6 NOVEMBER, the next international climate summit, called COP27, will begin in Sharm el-Sheikh, Egypt. Global leaders will once again shake hands, smile for the cameras and get down to the difficult business of negotiating how to mitigate global heating at the end of a year when its devastating effects became more obvious than ever before.

Last year's COP26 summit in Glasgow, UK, was billed as the world's last chance to keep the goal of restricting warming to 1.5°C alive. The Glasgow Climate Pact called on countries to come up with more ambitious plans for limiting or cutting emissions ahead of COP27.

Hardly any have done so. Egypt's own plans would lead to a 50 per cent rise in emissions by 2030, so it isn't exactly leading by example. And yet there are reasons for hope, albeit largely from beyond the climate summits, as we report on page 38.

The biggest obstacle to progress has been the energy crisis, caused by Russia's invasion of Ukraine. The problems have been severe because nations depend so heavily on fossil fuels, and yet they have led to a new rush to exploit even more. So don't expect any major announcements on emissions cuts at COP27.

> **"Some governments have realised that climate action is the answer to the energy crisis"**

Where there may be some progress is in efforts to make wealthy countries follow through on the $100 billion they have promised to provide to help other nations cut emissions and adapt to a warmer world. Adaptation has been neglected, but it is absolutely crucial to help limit the damage done as the planet warms.

The main cause for optimism stems from the fact that renewable energy is now the cheapest form of energy just about everywhere. Some governments have thus realised that climate action is the answer to the energy crisis. As the US's Inflation Reduction Act seeks to demonstrate, renewables are not only climate friendly, but also a stable, cheap, inflation-busting energy source. In the long run, then, the energy crisis could do more than any climate summit to boost global efforts to go green. ▮

PUBLISHING & COMMERCIAL

Commercial and events director Adrian Newton

Display advertising
Tel +44 (0)203 615 6456 **Email** displayads@newscientist.com
Sales director Justin Viljoen
Account manager Matthew Belmoh, Mila Gantcheva
Partnerships account manager David Allard

Recruitment advertising
Tel +44 (0)203 615 6458 **Email** nssales@newscientist.com
Recruitment sales manager Viren Vadgama
Key account manager Deepak Wagjiani

New Scientist Events
Tel +44 (0)203 615 6554 **Email** live@newscientist.com
Sales director Jacqui McCarron
Head of event production Martin Davies
Head of product management (Events, Courses & Commercial Projects) Henry Gomm
Marketing manager Emiley Partington
Events and projects executive Georgia Peart

New Scientist Discovery Tours
Director Kevin Currie

Marketing & Data
Marketing director Jo Adams
Director of performance marketing and audience development Jeffrey Baker
Head of campaign marketing James Nicholson
Head of customer experience Emma Robinson
Head of audience data Rachael Dunderdale
Senior email marketing executive Natalie Valls
Email marketing executive Ffion Evans
Digital marketing manager Jonathan Schnaider
Senior customer experience marketing manager Esha Bhabuta
Senior marketing executive Sahad Ahmed
Marketing executive Charlotte Weeks

Technology
Technology director Tom McQuillan
Maria Moreno Garrido, Dan Pudsey,
Amardeep Sian, Piotr Walków
Front end developer Damilola Aigoro
Junior front end developer Matthew Staines
Program manager Jennifer Chilton

NewScientist

Chief executive Nina Wright
Managing director Laurence Taylor
Executive assistant Lorraine Lodge
Team administrator Olivia Abbott

Finance & operations
Chief financial officer Amee Dixon
Commercial finance manager Charlotte Thabit
Commercial finance manager Anna Labuz
Management accountant Charlie Robinson
Commercial management accountant Alexandra Lewis

Human resources
Human resources director Shirley Spencer
HR business partner Purnima Subramaniam

CONTACT US

newscientist.com/contact

General & media enquiries
UK **Tel**+44 (0)203 615 6500
Northcliffe House, 2 Derry Street, London, W8 5TT
Australia 58 Gipps Street, Collingwood, Victoria 3066
US PO Box 80247, Portland, OR 97280

UK Newsstand
Marketforce UK Ltd **Tel** +44 (0)33 0390 6555

Syndication
Tribune Content Agency **Tel** +44 (0)20 7588 7588
Email tca-articlesales@tribpub.com

Subscriptions
newscientist.com/subscription
One year print subscription (51 issues) UK £270
Tel +44 (0)330 333 9470
Email subscriptions@newscientist.com
Post New Scientist, Rockwood House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH

© 2022 New Scientist Ltd, England.
New Scientist is published weekly by New Scientist Ltd. ISSN 0262 4079. New Scientist (Online) ISSN 2059 5387. Registered at the Post Office as a newspaper and printed in England by Precision Colour Printing Ltd

recycle
When you have finished with this magazine please recycle it.

EDITORIAL

Editor-in-chief Emily Wilson
Magazine editor Catherine de Lange
News and digital director Penny Sarchet
Creative director Craig Mackie

News
News editor Jacob Aron
Assistant news editors Chris Simms, Alexandra Thompson, Sam Wong
Reporters (UK) Madeleine Cuff, Michael Le Page, Jason Arunn Murugesu, Matthew Sparkes, Alex Wilkins, Carissa Wong
(Aus) Alice Klein

Digital
Audience editor Matt Hambly
Podcast editor Rowan Hooper
Senior video producer David Stock
Social media manager Chen Ly
Intern Kismat Shreet

Features
Head of features Daniel Cossins and Helen Thomson
Editors Colin Barras, Abigail Beall, Anna Demming, Kate Douglas, Alison George, Joshua Howgego
Feature writers Graham Lawton, Clare Wilson

Culture and Community
Comment and culture editor Alison Flood
Senior culture editor Liz Else

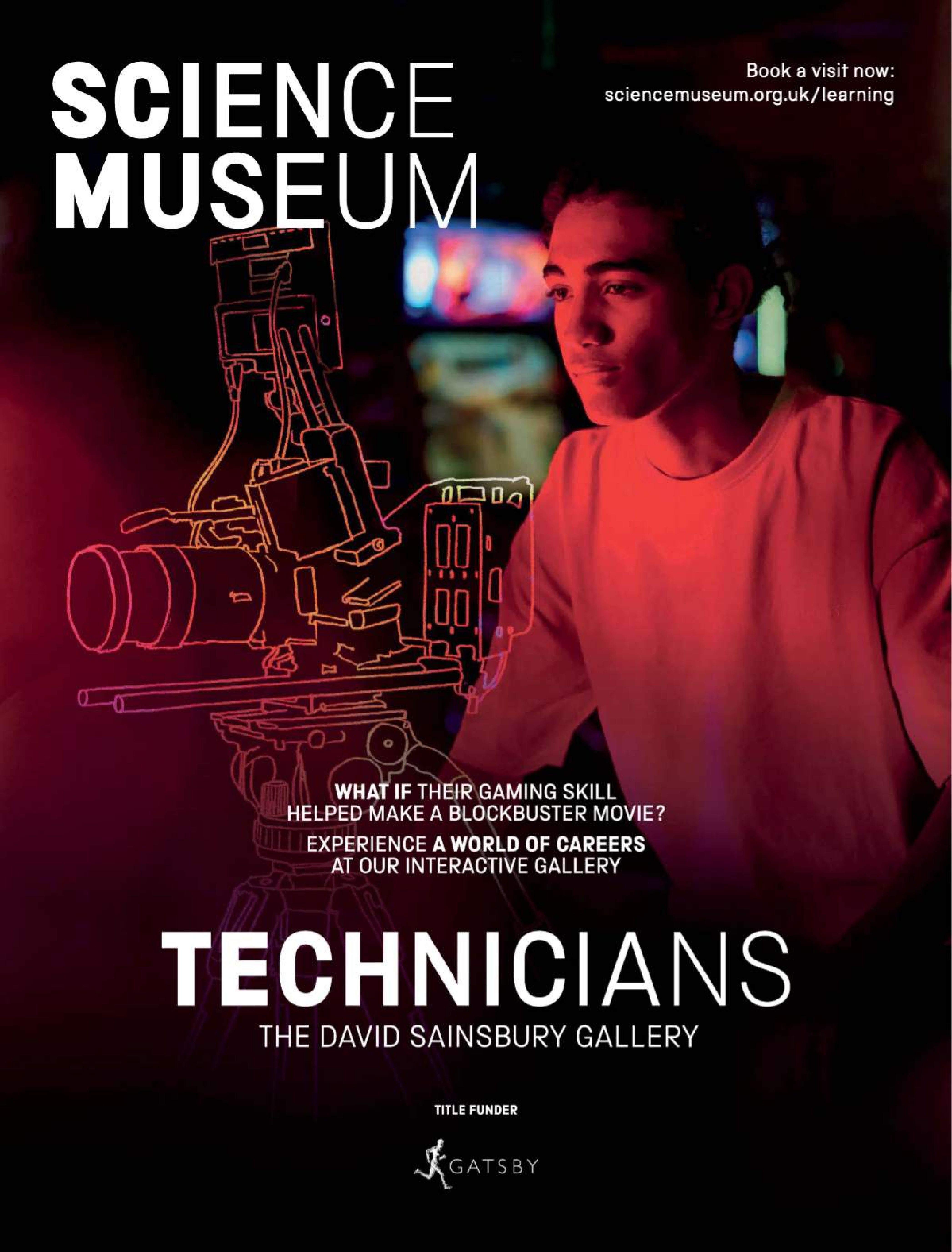
Subeditors
Chief subeditor Eleanor Parsons
Bethan Ackerley, Tom Campbell, Jon White
Trainee Tom Leslie

Design
Art editor Julia Lee
Joe Hetzel, Ryan Wills

Picture desk
Picture editor Tim Boddy

Production
Production manager Joanne Keogh
Production coordinator Carl Latter

New Scientist US
US Editor Tiffany O'Callaghan
Editors Timothy Revell, Chelsea Whyte
Reporters Leah Crane, James Dinneen, Jeremy Hsu, Karmela Padavic-Callaghan, Grace Wade, Corryn Wetzel
Subeditor Alexis Wnuk



SCIENCE
MUSEUM

Book a visit now:
sciencemuseum.org.uk/learning

WHAT IF THEIR GAMING SKILL
HELPED MAKE A BLOCKBUSTER MOVIE?

EXPERIENCE **A WORLD OF CAREERS**
AT OUR INTERACTIVE GALLERY

TECHNICIANS
THE DAVID SAINSBURY GALLERY

TITLE FUNDER

GATSBY

Pet tribute
High school student sequences his fish's genome **p9**

Floating sentinels
Weather sensors could stay airborne forever **p13**

Mosquito magnets
Why some people attract so many biting insects **p16**

Space protection
New aluminium alloy withstands high radiation **p19**

Killing machine
AI-guided laser weapon targets cockroaches **p23**

WILLIAM WEST/AFP VIA GETTY IMAGES

A flooded area in Melbourne on 14 October

Extreme weather

More floods in Australia

Continued extreme rain has flooded towns across eastern Australia and there might not be a let-up until 2023, reports **Alice Klein**

EASTERN Australia is experiencing major flooding for the fifth time in 19 months due to record-breaking wet weather that is predicted to stretch into next year.

Across October, heavy downpours have flooded large swathes of New South Wales, Victoria and Tasmania, resulting in four people dying, thousands of people being evacuated, homes and shops being inundated and roads being cut off and damaged.

In New South Wales, the worst-affected state, 43 local government areas have now flooded, mostly in rural areas, with some floods spanning hundreds of kilometres.

To try to limit the damage, more than half a million sandbags have been dispatched in recent weeks. "We are quite literally sandbagging the state," said Steph Cooke, emergency services minister for New South Wales, on 22 October.

The state was also badly hit by the four other major floods that have affected eastern Australia since early 2021, when the unusually wet conditions began. The widespread damage has made them the costliest floods in Australia's history.

"By the time we get through this event, we have almost the entire state at some point in time that has been affected by a natural disaster of one form or another," said New South Wales premier Dominic Perrottet at a press conference on 24 October.

In Sydney, the state capital, a record-breaking 2.4 metres of rain has been recorded this year. "We not only broke the record, we annihilated it," said Tom Saunders, a meteorologist at national broadcaster ABC, on 22 October.

Several parts of Victoria and Tasmania have also received record rainfall in recent weeks.

The 19 months of wet weather have primarily been driven by two large-scale weather systems originating in the oceans on either side of Australia, says Nina Ridder at the University of New South Wales in Sydney.

One is La Niña, a weather system arising in the Pacific Ocean that brings rain to Australia's east coast. A rare grouping of three La Niña cycles in a row since late 2020 has meant "basically no stop in the wet conditions", says Ridder.

The other is a weather system called the Indian Ocean Dipole, which occurs in the Indian Ocean and is currently in its negative phase, which brings more rain to south-eastern Australia.

Climate change may also be contributing because every extra 1°C of warming in the atmosphere means it can hold an extra 7 per cent of moisture that can then become rain, says Ridder.

"It will take time to quantify exactly how much human-caused climate change has influenced this specific event," says David Karoly at the University of Melbourne.

The reason the past few weeks have been particularly wet is because a high-pressure weather system off Australia's east coast has stopped rain clouds that have been sitting over the eastern states from moving offshore, says Ridder.

Eastern Australia should start to see drier conditions early next year when La Niña is predicted to end, she says.

The record-breaking floods come on the back of record drought, heat and wildfires that hit eastern Australia in 2019 and 2020. This is in line with government-commissioned modelling published in 2008 predicting that climate change would result in "longer dry spells broken by heavier rainfall events" in Australia.

"Climate change essentially means that extreme weather events are on steroids so they become more intense and frequent," says Karoly.

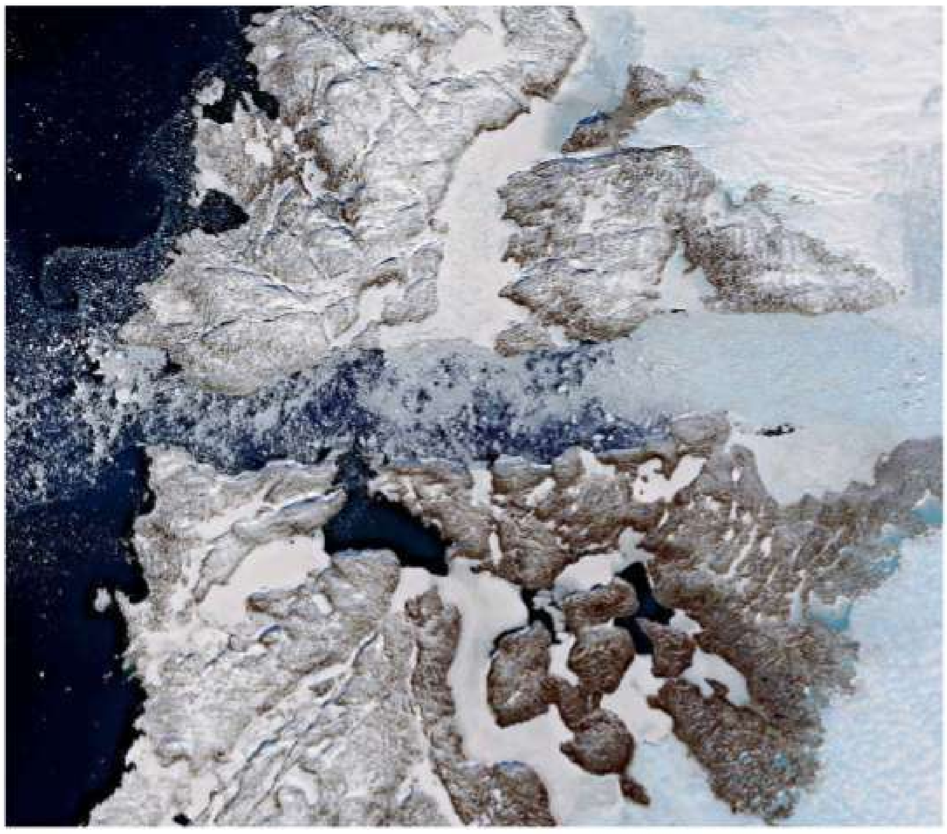
The extremely wet conditions are in stark contrast to the hot, dry conditions across the US, Europe and China in recent months, which are also thought to be associated with climate change. ■

Listen to more on this story
Download the New Scientist Weekly podcast
newscientist.com/podcasts

Climate change

Plan to save Greenland glacier

Engineering firms are contemplating an ambitious project that aims to slow ice melt and hold back catastrophic sea level rise, reports **Rowan Hooper**



COPERNICUS SENTINEL/ESA

Satellite view of Jakobshavn glacier in western Greenland

MAJOR engineering companies are looking at plans to slow the melting of a gigantic Greenland glacier, in what would be the first large-scale intervention to preserve ice anywhere in the world. If the scheme goes ahead, and if it works, it could suggest a way to slow sea level rise from Antarctic melt, too.

Norway's Aker Solutions and the Arup Group, based in London, sent representatives to a meeting in Reykjavik, Iceland, on 12 October in which proposals were discussed to construct a physical barrier to slow the ingress of relatively warm seawater to the base of the glacier.

"The design concept, essentially, is you take a heavy, premade set of concrete foundations that would be gently lowered onto the sea floor and they provide the anchor for a buoyant curtain," says John Moore, a glaciologist at the University of Lapland in Finland.

> **"Glacial curtains might be a very cost-effective approach to protecting us all from sea level rise"**

The target for the proposed intervention is the Jakobshavn glacier, the major drainage point for Greenland's ice melt. Recent research has found that melting on the underside of the Greenland ice sheet is progressing faster than anticipated. Moore's idea is that the curtain will reduce the flow of warmer water from the Atlantic Ocean to the base of the glacier.

Greenland's ice sheet, the second largest in the world after the one covering most of Antarctica, holds nearly 2.9 million cubic kilometres of ice – enough to raise global sea level by 7.2 metres if it all melted. That would take many hundreds of years, but at least 27 centimetres of sea level rise is already locked in, attributable to Greenland alone.

The mouth of Ilulissat fjord, where the Jakobshavn glacier terminates, is some 5 kilometres across, and the project would require a curtain to be lowered across the gap. Moore estimates the cost at less than $500 million per kilometre, so the total bill would come in at about $2 billion.

"This is significant funding," Moore told the *New Scientist Weekly* podcast. "But compare that with the costs of Greenland's contribution to sea level rise and the expected damages. It's far, far smaller. It's of the order of 1 per cent."

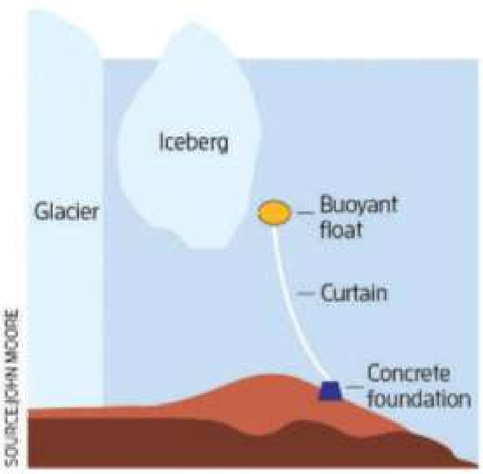
The impacts of sea level rise of a metre and up would be catastrophic. Hundreds of millions of people are thought to be at risk of flooding due to sea level rise by 2100, with the financial cost estimated at many trillions of dollars.

Many unknowns remain with the Greenland scheme. Prototypes would need to be built to test how, for example, icebergs pass over the curtain and to assess its impact on nutrient mixing in the fjord and on fish populations. The curtain would do nothing to slow surface melting on the glacier, which is significant and increasing. Time is a factor, too, and Moore says the project would take 30 years to construct.

Any construction project of this scale would also require consultation and buy-in from local people. Ilona Mettiäinen at the University of Lapland has been canvassing local attitudes to this kind of engineering intervention in Ilulissat, a town of some 4600 people near the Ilulissat fjord.

How a seabed-anchored curtain would work

A curtain would block warm water from reaching the base of the glacier



SOURCE: JOHN MOORE

Local consultation

"Greenlanders are concerned about climate change," she says. "The proposal to intervene is a new scientific idea, but the views have been both positive and slightly concerned about possible impacts on livelihoods associated with tourism and fisheries."

Hugh Hunt, an engineer at the University of Cambridge, says glacial curtains could slow down, and perhaps even reverse, the rate of melting of Arctic and Antarctic glaciers. "If curtains can be made to work, then they might be a very cost-effective approach to protecting us all from significant sea level rise caused by the melting of polar glaciers."

However, Poul Christoffersen, a glaciologist who is also at the University of Cambridge, says the idea wouldn't change the melting caused by the warmer atmosphere, which is currently the biggest concern in Greenland. He also points out that Antarctica's coastline is longer than Earth's circumference and that the Greenland ice sheet covers 1.7 million square kilometres.

"Geoengineering on this scale is unlikely to materialise any time soon," he says, nor on the timescale needed. "A green revolution for the necessary reduction in fossil fuel use is under way and it is crucial that it continues." ∎

Time

Quantum watch is 'a completely new way of measuring time'

Leah Crane

A QUANTUM watch can tell time without counting it. This stopwatch-like method of observing quantum experiments is a deceptively simple – and always accurate – way to measure the passage of time.

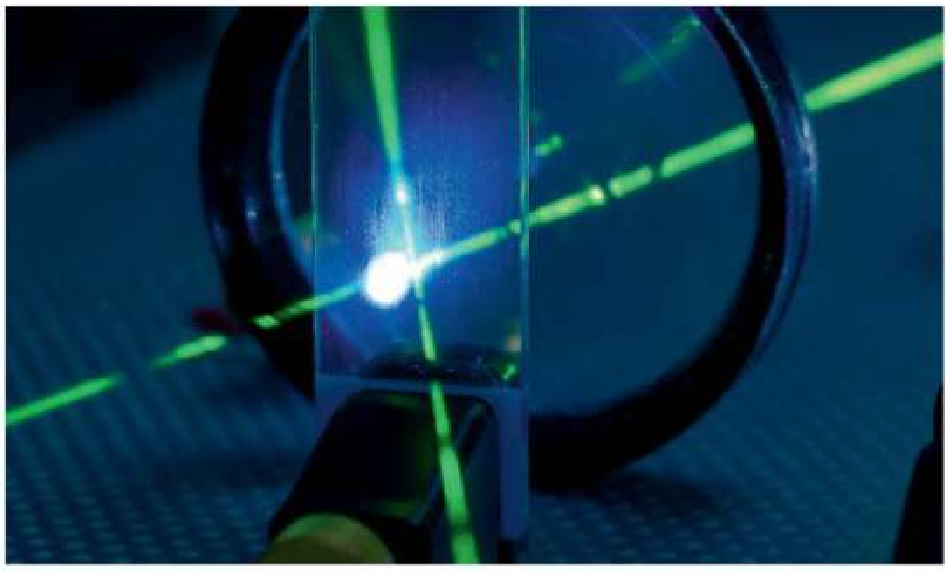
Marta Berholts at Uppsala University in Sweden and her colleagues based the clock on so-called pump-probe experiments. In these, a "pump" laser pulse is sent into a cloud of atoms, raising them to higher energy levels, and then another, less powerful "probe" pulse is used to measure the effect of the pump.

These experiments are crucial for many applications in materials science, notably the development of solar panels, but it can be hard to measure how much time passes between the pump and the probe. The new quantum watch, made with helium atoms, solves that problem.

"It's a completely new way of measuring time," says Ronny Knut, also at Uppsala University and part of Berholts's team. "With other clocks, you try to improve timekeeping by making it more and more complex. But in our case, we actually go the complete opposite direction: we use basically the simplest possible structure that could tell time."

The researchers first fired a laser beam into a cloud of helium atoms. This put the atoms into a superposition of quantum states, meaning that they were in multiple energy levels at once. These energy levels interact with one another – like how, in the famous double-slit experiment, a single photon can go through two openings at the same time – and create an interference pattern that changes over time.

Laser interference patterns can help measure time


SHUTTERSTOCK/LUCHSCHENF

When the researchers measured that interference pattern for as little as 1.7 trillionths of a second, they could compare it to simulations of the interference and find the unique slice of time where the patterns matched, telling them precisely how long the helium atoms had been in the superposition. The non-repeating nature of the interference pattern made it easy to demonstrate without a doubt that the timing was accurate (*Physical Review Research*, doi.org/jhzh).

The benefit of this is that, unlike with a traditional clock, there is no need to measure exactly when the atoms were put into a superposition. "You just look at the interference structure and say, 'OK, it's been 4 nanoseconds'," says Berholts.

Gerard Milburn at the University of Queensland in Australia says the approach could be extraordinarily accurate in experiments where all that needs to be measured is a delay between two times.

Such experiments are ubiquitous when studying small-scale systems that change quickly. The improvement in accuracy could allow researchers to make extremely fast measurements of systems that change over time, such as a single molecule falling apart, quantum interactions between light and matter or a material being exposed to a magnetic field. ▮

Biology

High school student sequences genome of his pet angelfish

A 17-YEAR-OLD high school student in California has sequenced the genome of the freshwater angelfish (*Pterophyllum scalare*) for the first time.

Indeever Madireddy sequenced the genome of his pet angelfish Calvin after it died in March this year. "Although my fish was dead, I wanted to preserve it forever," he says. "So I decided to sequence the genome of the angelfish with the hopes that I could contribute that information to the scientific community, while also paying a small tribute to my pet!"

Madireddy did the sequencing at BioCurious, a community lab in Santa Clara, California, that makes advanced equipment available to anyone for a small membership fee. He stored his fish at -80°C at the lab to preserve its DNA, then spent around a month preparing and learning how to sequence it.

The sequencing was done over two weekends with a small sequencer made by Oxford Nanopore. These machines read off the sequence of DNA molecules as they pass through tiny pores.

Analysing the data took another two months and a lot more learning, says Madireddy. The sequence data has been put on a public database and a short paper describing the work was published on 18 October (*microPublication Biology*, doi.org/jhw3).

The sequencing cost around $2000, says Madireddy, of which he managed to raise nearly $1000 by crowdfunding.

"I hoped to contribute to the scientific community, while also paying a small tribute to my pet"

"This is a wonderful example of an inquisitive spirit and what young scientists can do when you remove technology barriers like cost and complexity," says Gordon Sanghera, CEO of Oxford Nanopore.

Madireddy is a keen fish-keeper and biologist, and has previously done work using CRISPR gene editing. He had raised Calvin from the egg stage along with other hatchlings. "The rest of the angelfish are still happy and healthy in my aquarium," he says. ▮

Michael Le Page

GET AN EXTRA 20% OFF
HURRY, OFFER ENDS 31 OCTOBER 2022

New Scientist Subscriptions

67 Ho Holmium	29 Cu Copper	16 S Sulfur	84 Po Polonium	29 Cu Copper	16 S Sulfur

Let rationality, evidence and clear-thinking combat misinformation with confidence and optimism. Know your facts from fiction with a subscription to *New Scientist*.

GET AN EXTRA 20% OFF*

Get an EXTRA 20% off in our Halloween flash sale.
But hurry, offer ends 31 October 2022.

To find out more, visit
newscientist.com/18996
Or call +44 (0) 330 333 9470, quoting 18996

*Offer available on 'web access', 'digital access' and 'print and digital access' subscriptions. Offer entitles the user to an additional 20% off current Christmas 2022 pricing. This is an auto renewing subscription. In the unlikely event that you wish to cancel your subscription, we offer a 14-day cooling-off period after the initial payment is made. Offer ends 31 October 2022.

Diet

Turmeric supplements have been linked to liver damage in five people

Alice Klein

TURMERIC supplements and teas may have caused five cases of liver injuries that made people's skin turn yellow. All those affected recovered with treatment.

The spice contains a compound called curcumin, which has slightly eased inflammatory conditions such as arthritis and hay fever in small studies.

Some turmeric-related liver injuries have previously been reported to the US National Institute of Diabetes and Digestive and Kidney Diseases. Five new incidences were presented at the annual scientific meeting of the American College of Gastroenterology in North Carolina this week.

One case, presented by Angeline Luong at the Kaiser Permanente Los Angeles Medical Center in California, was a 49-year-old woman who developed nausea and vomiting after taking a daily turmeric supplement, at the dose recommended on the packaging, for three months.

Her symptoms resolved when she stopped taking the supplement, but returned when she resumed the regimen. She also developed yellowing to her skin and the whites of her eyes. Blood tests and a liver biopsy revealed she had a severe liver injury.

The woman's skin and eyes turned yellow because her liver was unable to perform its normal function of processing bilirubin, a yellow substance made during the breakdown of red blood cells, leading to jaundice, says Luong.

The woman recovered after she was given steroids and N-acetylcysteine, a medicine normally used to treat paracetamol (acetaminophen) overdoses. She was discharged after three weeks in hospital.

Similar cases were presented by researchers based in New York, Florida and New Jersey, with the affected all taking the recommended dose on the supplement packaging.

In addition, Prisca Pungwe at Baylor College of Medicine Texas described how a 62-year-old woman developed nausea, abdominal pain and yellow eyes after drinking a turmeric tea for three weeks, with tests confirming she had a liver injury. The woman recovered with treatment.

The vast majority of people who take turmeric supplements don't develop liver injuries, but certain genetics can make people more susceptible, says Ken Liu at Royal Prince Alfred Hospital in Sydney, Australia. Herbal supplements are metabolised by enzymes in the liver that are genetically different between people, with some processing the supplement into a toxic substance, says Liu.

Supplements are riskier than eating turmeric in food because they often contain additives to increase curcumin's absorption, says Luong. For example, adding black pepper to supplements and teas can increase curcumin absorption 30-fold. When turmeric and black pepper are used in cooking, they make up a mix of ingredients that limits absorption.

People with liver injuries don't always mention supplement use when a doctor asks if they are taking any medicines, delaying diagnosis, says Liu. ▮

SCIENCE PHOTO LIBRARY/ALAMY

Turmeric may ease some inflammatory conditions

Health

Hypnotherapy app eases IBS symptoms in just six weeks

USING a hypnotherapy-based app may ease irritable bowel syndrome (IBS). Nerva guides users through a 10-minute hypnotherapy session every day for six weeks.

The causes of IBS aren't fully understood, but disordered signalling between the gut and brain could be a culprit.

Hypnotherapy may ease this by directing an individual into a trance-like state and suggesting that their symptoms are improving.

In 2016, Simone Peters at Monash University in Melbourne, Australia, and her colleagues published promising results of a trial that compared the effects on IBS of in-person hypnotherapy and the low FODMAP diet, which involves eliminating certain foods that can trigger the condition.

To make the therapy more accessible, Peters developed Nerva. At the beginning of each session on the app, users are drawn into a trance-like state by being asked to relax different body parts, a "body scan". Next, they imagine a scenario, like collecting a bespoke medicine. They are then told statements like, "there will be no more pain, no more bloating and no more discomfort".

At the beginning and end of the six-week programme, users rate their symptoms. On average, people who complete the programme report a fall in symptom severity from 67 to 39 out of 100.

This is on a par with the effectiveness of in-person hypnotherapy and the low FODMAP diet, says Peters, who presented the results at the annual American College of Gastroenterology meeting in North Carolina. The app's efficacy wasn't tested against standard IBS treatments.

Lisa Shim at Macquarie University in Sydney, Australia, says the app could improve the quality of life of people with IBS.

Only about one-fifth of people who download Nerva complete the programme, with this level of adherence being common for health apps, says Peters. ▮ AK

> "App users are told things like: 'There will be no more pain, no more bloating and no more discomfort'"

Animal behaviour

Dozens of turtle species use vocal sounds to communicate

Christa Lesté-Lasserre

JORGEWICH-COHEN ET AL.

The juvenile painted wood turtle isn't silent after all

VOCAL communication is much more widespread in vertebrate animals than we thought.

Gabriel Jorgewich-Cohen at the University of Zurich, Switzerland, and his colleagues collected recordings from 53 species that were previously thought to be non-vocal: the tuatara (*Sphenodon punctatus*), the Cayenne caecilian (*Typhlonectes compressicauda*), the South American lungfish (*Lepidosiren paradoxa*) and 50 species of turtles.

Rather than evolving in many animals independently, the research suggests that vocal communication arose in a common ancestor more than 400 million years ago.

Many vertebrates with lungs – a group known as choanate vertebrates – create sounds through structures in their throats as they push air up through the lungs. They use these sounds in social interactions like parental care, mate selection, territory marking and other behaviours that benefit from vocal communication.

407mya

Estimated time when certain vertebrates first vocalised

However, researchers have overlooked at least 100 choanates in vocal communication studies, says Jorgewich-Cohen. Even though they could occasionally be heard making sounds, it was assumed that these noises were either created by accident or they were intended to defend themselves from other species – and hence that they couldn't be considered true vocal communication.

In particular, people have often incorrectly assumed that turtles are non-vocal, says Jorgewich-Cohen. After participating in a field study on vocal communication in turtles, he was inspired to investigate further – starting with his own pet turtles. "I decided to record them, just to check it out," he says. "I found several sounds there, and then we just kept going [with more species]. And suddenly, I had good sampling and I could understand a bigger picture."

The 53 species the team studied had a varying range of acoustic capabilities, from chirps and clicks to more advanced, complex sounds of different tones. Many researchers agree that when animals use their respiratory tracts to create complex repertoires of different sounds or harmonic calls, they are communicating with each other, says Jorgewich-Cohen.

He also filmed with underwater cameras while recording sound to see what behaviours might be linked to the noises. The most obvious forms of communication were produced by males while courting females or during conflicts with other males.

By combining their findings with data collected previously on 1800 additional species of choanates, Jorgewich-Cohen and his colleagues determined that acoustic communication evolved in nose-breathing vertebrates about 407 million years ago (*Nature Communications*, DOI: 10.1038/s41467-022-33741-8).

Gerald Kuchling at the University of Western Australia says it is interesting that turtle vocalisations have been ignored for so long.

"I am not surprised that all of them appear to vocalise," he says. "I think it is significant that inserting this finding into a phylogeny [evolutionary tree] reveals this as an old, basic common trait of choanates generally." ▮

Ecology

California mountain lions took more risks after huge wildfire

Corryn Wetzel

AFTER a 2018 wildfire, mountain lions near Los Angeles were more likely to cross roads, travel further and be active during the daytime – when encounters with people are most likely. The shift to bolder behaviour concerns researchers, who note that increasing wildfires may jeopardise the urban cats' future.

The wooded Santa Monica mountains north of Los Angeles are home to around 100 mountain lions, which, despite being bordered by large highways and human development, have managed to survive by hunting mule deer.

After the 2018 Woolsey fire scorched more than 400 square kilometres of land – roughly half of the cats' habitat – Rachel Blakey, now at California State Polytechnic University, Pomona, and her colleagues compared data from GPS tracking collars on 17 mountain lions before and after the blaze.

They found significant differences in the mountain lions' behaviour after the fire. In the 15 months following the blaze, the cats' average number of road crossings jumped from three to five per month, and their monthly distance travelled increased from 250 kilometres to 390 kilometres. The mountain lions were also more likely to come into close contact with other mountain lions, which can lead to fighting between the solitary cats (*Current Biology*, doi.org/gq3pmm).

The researchers believe these changes probably reflect their desire to stay away from other mountain lions and a desperation to find and hunt food without the camouflage of vegetation.

"The size and location of this fire really lent itself to asking some of those bigger questions about the interaction of fire and urbanisation," says Megan Jennings at San Diego State University in California. ▮

Technology

Weather sensors that float forever

A device that uses sunlight to levitate could stay in the stratosphere indefinitely

Karmela Padavic-Callaghan

SMALL sensors powered only by sunlight could float in the sky indefinitely and make weather-related measurements.

Flat objects with two sides can be levitated by what is called photophoresis. This occurs when one of the sides absorbs lots of light and the other very little, creating a difference in temperature. Just like how temperature differences in the atmosphere cause winds, this temperature gradient makes molecules move in such a way as to create a lifting force on the object.

Benjamin Schafer at Harvard University and his colleagues designed a device that could use photophoresis to levitate small atmospheric sensors that wouldn't need motors or batteries to stay aloft. While photophoretic devices have been tested before, the researchers designed a larger version optimised for carrying sensors.

Their device consists of two aluminium oxide discs about 10 centimetres in diameter. Each disc is only 100 nanometres thick – one-thousandth the thickness of a sheet of paper – and microscopic holes cover nearly half of the surface, making it very lightweight and easy for heat to flow through it. To maximise the lifting forces on the device, the team determined that the top disc should be covered in a coating that lets visible but not infrared light pass through it, while a coating on the bottom disc did the opposite.

This would generate enough lift to keep the device in the stratosphere, bobbing up and down over the course of a day and night as light switches from mostly visible to mostly infrared, but never falling to Earth. The researchers calculated that the device could carry a 300-milligram payload of equipment, such as temperature and pressure sensors and instruments for transmitting measurements to Earth (arXiv, doi.org/jhw8).

Schafer and his colleagues suggest a weather balloon could deliver hundreds of these devices to the stratosphere, about 25 kilometres above the equator. Here, they could make measurements of stratospheric winds, which are useful for predicting weather. Because they are small and light, they could also be practical to transport to Mars, where they could collect data about the Martian atmosphere.

Karen Aplin at the University of Bristol, UK, says that the devices might be helpful for a form of solar geoengineering where aerosol particles would be injected into the stratosphere to reflect sunlight and cool Earth. Floating photophoretic aerosol sensors could continuously monitor that process, she says.

However, Aplin says, the device's 300-milligram mass allowance may challenge its practicality. Many instruments would have to be powered by solar cells and adding those, together with connective circuits and mounting elements, could limit how many more instruments can be added, she says. ▮

Sunlight could help keep tiny weather sensors floating in the sky

NASA

Health

Cannabis users experience more pain after surgery

PEOPLE who used cannabis within a month before surgery experienced greater pain after their operations than those who didn't.

Given its widespread use, and the fact that cannabis with high amounts of the psychoactive compound THC has been shown to provide some pain relief, researchers wanted to understand how it could affect the experience of pain after surgery.

Elyad Ekrami at Cleveland Clinic in Ohio and his colleagues looked at data on 34,505 adults who underwent surgery at the centre between January 2010 and December 2020. Of the participants included in the study, 1683 reported using cannabis within 30 days before surgery, while the rest didn't.

Everyone rated their pain 24 hours after surgery on a scale of 0 to 10, with 0 indicating no pain and 10 indicating the worst pain possible. On average, people who reported using cannabis in the month prior to their surgery rated their pain a 5.5 compared with a pain score of 4.1 for those who didn't report using cannabis in that time period. After adjusting for factors including age, surgery type, psychiatric history and other substance use, researchers still found a statistically significant difference in average pain scores, of 0.58 points, between the two groups.

Average opioid use to relieve post-surgical pain was also 7 per cent higher in people who used cannabis compared with those who didn't. While this difference wasn't statistically significant, it warrants future investigation, says Ekrami, who presented the findings on 23 October at the American Society of Anesthesiologists's annual meeting in New Orleans, Louisiana.

A key limitation of this study is that people could have misreported their cannabis use over fears of being judged or having their procedure cancelled, says Michael Alaia at NYU Langone Health in New York City. ▮

"Average opioid use to relieve post-surgical pain was 7 per cent higher in people who used cannabis"

Grace Wade

Astronomy

Space telescope glimpses the smallest distant galaxy

Alex Wilkins

THE James Webb Space Telescope (JWST) has spotted the smallest galaxy outside our local universe by using the heaviest known cluster of galaxies, called El Gordo, as a giant lens. The mini galaxy is a thousand times less massive than the Milky Way.

El Gordo was first discovered in 2011. Follow-up measurements found that it contained so much mass – the equivalent of 3 million billion suns – that it was at the very limit of what standard cosmological theory predicts.

This huge mass makes it useful as a gravitational lens, bending and magnifying the light from stars and galaxies on the other side of it that would otherwise be invisible to us.

Now, Jose Diego at the University of Cantabria in Santander, Spain, and his colleagues have used JWST to observe the infrared light from El Gordo and found 29 galaxies that hadn't been visible before, including a dwarf galaxy that is only a billion times heavier than our sun. Even dwarf galaxies typically contain a few billion stars.

The team identified the dwarf galaxy from a strange fluctuation of light from another galaxy, called La Flaca, that El Gordo had stretched into a pancake-like arc. "The only way to explain it is there is a small, tiny galaxy right there, which is probably a dwarf galaxy," says Diego.

The galaxy is believed to be a thousandth of the mass of the Milky Way. If this is confirmed, it would be the smallest galaxy seen outside our local universe – which includes the Milky Way and its associated galaxies.

Its existence could present problems for some physics models, says Diego. "The fact that you can see this galaxy is inconsistent with some models of dark matter that predict that dark matter could have a high temperature." Warm dark matter would have a velocity too high to form a galaxy this small, he says.

Diego's team also spotted a red supergiant star, a type of star that hadn't been seen outside our local universe, but that JWST could identify using its infrared sensors (arxiv.org/abs/2210.06514).

If stars that fluctuate in brightness – which also tend to be red like this supergiant – are found by JWST, then they could be used to accurately estimate distances for very distant objects and measure the expansion of the universe. Currently, we use supernovae for this, which can be inaccurate.

29

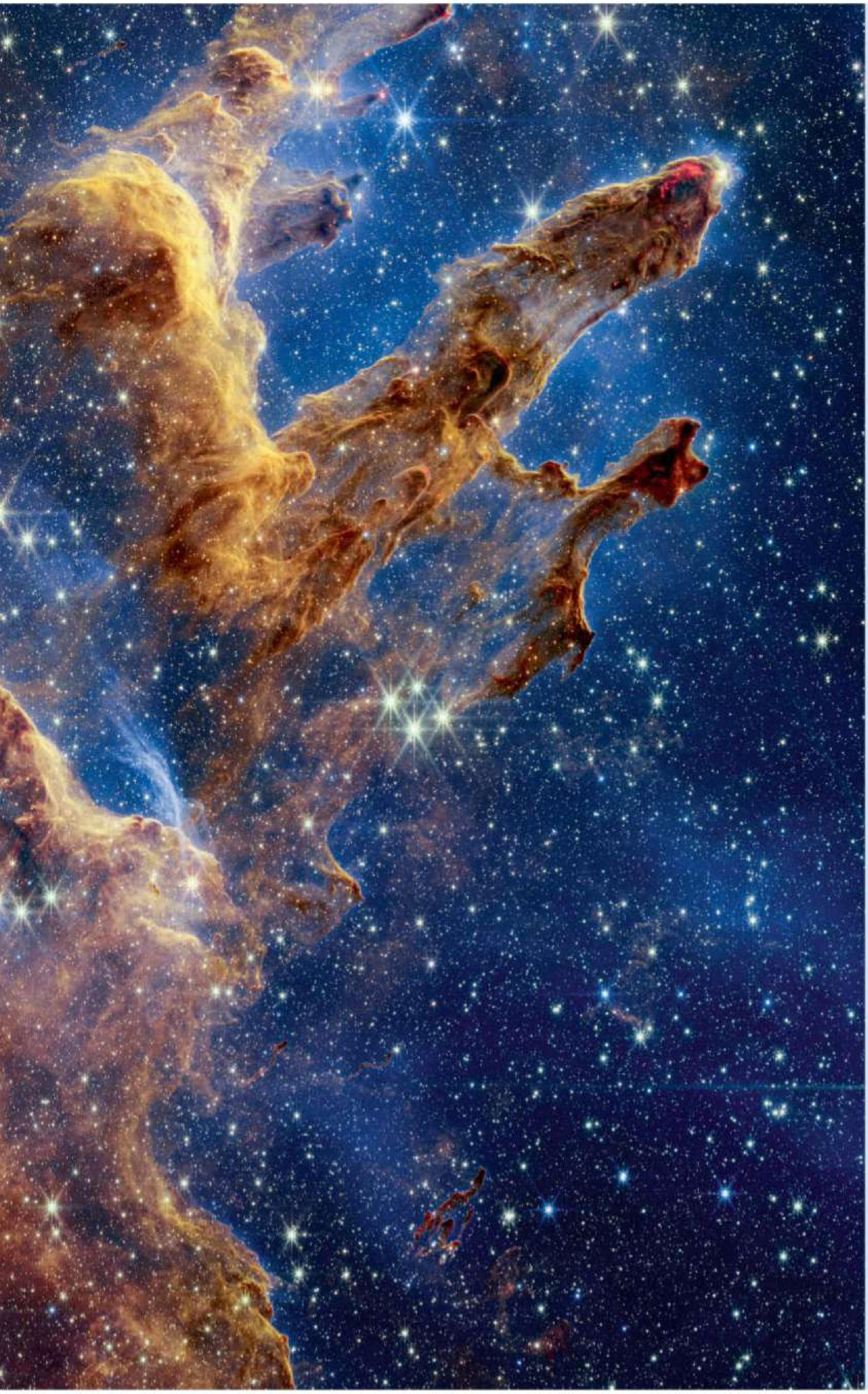
The number of newly observed galaxies detected by the team

Seeing such distant dwarf galaxies and red supergiant stars for the first time is "pretty amazing", says Felipe Menanteau at the University of Illinois at Urbana-Champaign. However, on their own, these objects won't be enough to help inform our models of the universe's formation; more data is needed for that, he says.

Diego and his team also found fewer very distant galaxies than expected behind El Gordo. These correspond to an era in the history of the universe called reionisation when the first stars began to form. This is strange given El Gordo's unique size and strength as a lens, says Menanteau, and hints that there might be something missing in our understanding of the formation of the first galaxies. ■

Read Chanda Prescod-Weinstein on the contradictions of the James Webb Space Telescope on page 28

NASA, ESA, CSA, STSCI; J. DEPASQUALE, A. KOEKEMOER, A. PAGAN (STSCI)



Space

Pillars of Creation look even starrier in new JWST image

OUR view of the iconic Pillars of Creation has been transformed by the James Webb Space Telescope (JWST). While these towering clouds of dust and gas, which are 6500 light years away in the Eagle Nebula, look like solid cosmic stalagmites in the classic images from the Hubble Space Telescope, JWST images reveal the stars forming within them.

JWST is able to see through the dust because it observes in infrared wavelengths of light, as opposed to visible light that Hubble mostly uses. Infrared light pierces through the clouds of dust and gas to show the young stars that have just formed or are still forming in this stellar nursery.

Many of the brightest stars in this image have only recently formed within the pillars and then blown away their surrounding gas. Some of these bright stars are surrounded by eight spikes of light, which are simply caused by the extremely bright starlight bouncing off the edges of JWST's mirrors.

The dark lines at the edges of the clouds come from even younger stars, which formed only a few hundred thousand years ago. When these kinds of stars are still forming, they blast out jets of plasma. The jets slam into the gas and dust around them and create shock waves, which pick up more material as they propagate through the cloud.

Observing these young stars may help us learn more about the process of star formation – how dust and gas form tight knots that then collapse into stars. It could also help us track what happens once the stars form in a region like this and how they emerge from their pillar-like cocoons. ▮

Leah Crane

Analysis Energy

Can geothermal energy heat the UK? Underground heat could end the country's reliance on gas, say MPs, but exploiting this potential isn't straightforward, says **Madeleine Cuff**

NEVER mind the gas crisis – beneath the UK lies enough free heat to keep the country warm not just this winter, but every winter for decades to come.

That is according to UK members of parliament on the Environmental Audit Committee (EAC) who wrote to the business secretary, Jacob Rees-Mogg, on 19 October claiming that there is enough geothermal energy in the UK to meet the country's annual heating demand for at least a century.

"The evidence received by the Committee was clear and consistent: the UK has significant geothermal resources which can contribute to both the UK's energy security and its transition to net zero," wrote EAC chair Philip Dunne.

Given such huge resources, the EAC argues that the government should be doing much more to bring geothermal projects to fruition – particularly in the face of spiralling gas prices. But can the UK really ditch gas boilers completely and heat all its homes with warmth from underground?

> **"Spiralling gas prices might just be the push politicians need to finally tap the UK's reserves"**

Geothermal energy, which involves extracting the heat from Earth and using it for heating and electricity, currently delivers less than 0.3 per cent of the UK's annual heat demand.

Geologists agree there is great potential to scale the contribution up. But figuring out exactly how much of the UK could run on geothermal energy is less straightforward.

The most comprehensive study to date on the UK's geothermal resources is more than 40 years old. The paper concluded that there is at least 200 years' worth of heating and hot water in sedimentary basins around the UK.

Later studies have made slightly more conservative estimates. A 2017 paper by Jon Gluyas at Durham University, UK, and his colleagues suggests that geothermal energy resources in the UK are sufficient to deliver about 100 years of heat supply for the entire country.

So the EAC is in the right ball park when it talks about the potential heat under the feet of those in the UK. But translating that potential into warm homes over winter isn't so simple, says Gluyas.

"The next question is could you get at it and could you supply it to where people live and work," he says. "That's when it gets a little more difficult."

Geologists know very little about the deep geology of the UK, particularly when it comes to predicting temperature and water flow, essential details for scoping out potential geothermal projects.

This means there is huge uncertainty around the amount of heat available from the UK's deep geothermal resources. In many cases, developers need to drill new boreholes to test the geothermal potential of a site, a very expensive process, particularly when there is no gold rush of oil waiting at the bottom of the well.

Against the odds, some developers are making it work. When it opens in Cornwall next year, the United Downs Deep Geothermal Power project will become the UK's first geothermal power plant. But getting the scheme off the ground took more than a decade, including five years to secure funding, says Ryan Law, founder of Geothermal Engineering, the firm behind the project.

He agrees with MPs that the UK government needs to step in to incentivise investment in geothermal. Spiralling gas prices might just be the push politicians need to finally tap the UK's considerable reserves, says Law. ■

GEOTHERMAL ENGINEERING LTD

United Downs Deep Geothermal Project in Cornwall, UK

Animal behaviour

Why mosquitoes bite some people more than others

Jason Arunn Murugesu

AN ACIDIC byproduct made by skin bacteria may make some people more attractive to mosquitoes.

Maria Elena De Obaldia at the Rockefeller University in New York and her colleagues asked eight people to wear sleeves made from nylon for 6 hours.

A nylon swatch from a sleeve was then placed in one of two boxes, with the second box containing nylon worn by another of the participants. A third box held female *Aedes aegypti* mosquitoes, attached to the other boxes via a tunnel.

In various fabric combinations, the nylon worn by people with high levels of carboxylic acids in their body odour was the most attractive to the insects (*Cell*, doi.org/gq3dfc). Bacteria produce these acids when making the waxy substance sebum.

It may not be possible to change our production of carboxylic acids. "Human skin odour may be affected by genetic factors, skin microbiome and diet," says De Obaldia.

The team repeated the experiment with genetically modified mosquitoes that have a reduced ability to sense the acids. Fewer were attracted to the nylon, but they could still differentiate fabrics from "mosquito magnets".

"I think this reflects [the fact] that mosquitoes are choosing who to bite based on several – potentially many – odours emanating from our skin," says De Obaldia.

This research could lead to GM mosquitoes that are less likely to bite and transmit disease, says George Christophides at Imperial College London. ■

TACIO PHILIP SANSONOVSKI/ALAMY

Aedes aegypti mosquitoes can transmit the Zika, dengue, yellow fever and chikungunya viruses

YOU BEAUTY
Advent Calendar
2022

The YOU Beauty Advent Calendar is here!

This year we've teamed up with these amazing brands to bring you the best calendar to date. Featuring full sized and travel sized products to make your countdown to Christmas extra special.

ONLY £70
WORTH OVER £365

FREE DELIVERY

able skincare LONDON
absolute collagen
AROMA ACTIVE LABORATORIES
AROMATHERAPY ASSOCIATES
athletis
avant
BALANCE ME
benefit
bliss
bloom & blossom
EH
/kit·sch/
Murad.
MOLTON BROWN LONDON
LEIGHTON DENNY EXPERT NAILS
NAILS.INC LONDON
pai.
PHILIP KINGSLEY
RITUALS
Rodial
ROGER & GALLET
thisworks

SHOP NOW AT YOUBEAUTYSHOP.CO.UK

USE CODE **NEWSCIENTIST** FOR **£5 OFF** (USUAL SELLING PRICE £75)

Stock subject to availability. Usual selling price online is £75 (including P&P). We reserve the right to substitute products due to demand. You will be substituted a product of the same RRP. For full information, visit youbeautyshop.co.uk. Delivery charges/restrictions may apply. Returns: notify us within 14 days of receipt via the 'Contact Us' section on the website. YOU Beauty is a brand of Associated Newspapers Limited, 2 Derry street, London W8 5TT.

FREE ONLINE EVENT

New Scientist Debate

ONLINE EVENT

THE FUTURE OF LIFE SCIENCES IN A RAPIDLY CHANGING WORLD

Thursday 17 November 2022 12.30 – 1.30pm GMT and on demand

Our ability to develop, manufacture and distribute therapeutics has changed dramatically with covid, Brexit and the increasingly volatile geopolitical landscape. That has created numerous challenges for life sciences companies in the risks they face, in securing supply chains and in managing regulatory affairs. But periods of great change bring opportunities too as new products and approaches emerge and markets evolve.

Join our panel of experts to discuss the forces buffeting the biotech and pharmaceutical industries and the transformational changes that are becoming possible.

CONFIRMED PANELLISTS INCLUDE

Anusha Foy
Head of Life Sciences Biotech Regulatory Solutions Practice, KPMG

Alan Morrison
Vice President of Regulatory Affairs International, MSD

Richard Torbett
CEO, Association of the British Pharmaceutical Industry

Find out more and register:
newscientist.com/kpmgevent

Sponsored by KPMG

Genomics

Dyslexia linked to genetic variants

A genetic test could one day assess whether a child is predisposed to have dyslexia

Christa Lesté-Lasserre

IN THE largest genetic study of dyslexia to date, scientists have identified 42 genetic variants that may influence a person's chance of having it.

Dyslexia, which affects up to 1 in 10 people in the UK to some extent, often affects a person's ability to read, write and spell.

Although the cause is unknown, previous research suggests that dyslexia is inherited, with smaller studies linking it to a few genes.

To get a wider view of dyslexia's potential genetic associations, Michelle Luciano at the University of Edinburgh, UK, and her colleagues carried out a genome-wide association study on 1.1 million adults, mainly of European origin, of whom 51,000 said they had been diagnosed with dyslexia.

The researchers identified 42 genetic variants that tended to differ between the participants who did and didn't have dyslexia. The more of these variants an individual had, the higher their chance of having dyslexia, the results suggest (*Nature Genetics*, doi.org/jhkd).

Referring to dyslexia, Luciano says: "It's a complex trait and like lots of complex traits, it's influenced by many genes and each of them by itself has a very small effect on the increasing genetic predisposition of dyslexia."

Next, the team created a scoring system for a separate group of 2800 adults and teenagers, based on testing their genes for the dyslexia-associated variants.

Dyslexia often affects a person's ability to read, write and spell

SHUTTERSTOCK/PALAWAT744

A higher score was linked to these participants showing more signs of dyslexia on a reading and spelling test. It isn't known whether any of them had been diagnosed with dyslexia.

Around one-third of the 42 variants had previously been linked to conditions such as attention deficit hyperactivity disorder. The remaining links were more novel, with some of these variants also being associated with a lower pain threshold and being ambidextrous.

The genetic variants may alter a neurodevelopmental process, says In-Hyun Park at Yale University. This could then affect multiple connections between a person's neurons, which may result in dyslexia, pain sensitivity and ambidexterity, he says.

The 42 genetic variants may not cause dyslexia per se, but could make it more or less likely to occur if combined with certain learning styles, says Luciano. For example, phonics teaches children to match certain letters with sounds and may be particularly helpful for people with dyslexia, she says.

"When people think of genetics, the first thing they might think is that it's something that's fixed and we know that that's simply not the case," she says. "Genes operate within environments, so the environment is really important to consider."

While much more research is required, the findings could one day lead to a genetic test that identifies children who are predisposed to have dyslexia, says Luciano. This could allow for interventions that reduce reading and writing difficulties, she says. ■

Materials

Radiation-resistant alloy could boost spacecraft shielding

AN ALUMINIUM alloy that is 100 times more resistant to radiation damage than a common spacecraft material could be used to improve shielding in crew capsules or build houses on Mars.

Aluminium alloys are often used in space because they are both lightweight and strong. But when they are exposed to powerful radiation from the sun or galactic rays for long periods of time, their molecular structure can change, making them weaker.

In 2019, Stefan Pogatscher at the University of Leoben in Austria and his colleagues created a new alloy by mixing an aluminium and magnesium alloy with zinc and copper, then crushing it at extremely high pressures. The resulting material kept its structure and hardness after being exposed to high levels of radiation. But it also became brittle, which rendered it useless for space applications.

Now, Pogatscher and his team have modified their alloy by heating it to more than 200°C. This caused the grains that make up the alloy to be smaller, which helped it keep its flexibility and strength after irradiation. "We have solved this problem in a way that [means] the material doesn't embrittle, and also the phase is still stable up to very high irradiation limits," says Pogatscher.

The researchers used an electron microscope to examine the effect of bombarding the material with different doses of energetic heavy ions. They found that the alloy was 100 times more resistant to doses of radiation than an alloy of aluminium called 6061, which is widely used in spacecraft (arXiv, doi.org/jhkq). This would make the material well suited for spacecraft that have to spend very long periods under constant irradiation.

"For space applications, this is a highly significant step forward in terms of radiation resistance"

"For lightweight alloys, for space applications, this is a highly significant step forward in terms of radiation resistance," says Russell Goodall at the University of Sheffield, UK. ■

Alex Wilkins

Artificial intelligence

AIs built by Meta beat human experts at Diplomacy game

Jeremy Hsu

TWO AIs built by Meta can beat expert human players at the classic first world war strategy game Diplomacy. The AIs had to learn how to partly cooperate with other players, an element most other game-playing AIs don't have to take into account.

"There's a quite unique feature here of Diplomacy being collaborative and competitive at the same time, which makes it exciting," says Georgios Yannakakis at the University of Malta, who wasn't involved in the study.

Diplomacy involves up to seven players fighting for control of European territories. To build a proficient AI player, a team led by researchers at Facebook's parent company Meta first tried a typical AI trial-and-error algorithm called reinforcement learning.

This technique has helped AI dominate games such as chess, Go and poker, but the team found it is far less effective for Diplomacy. "[In] games involving cooperation, self-play alone no longer guarantees good performance when playing with humans," wrote the researchers in their paper.

The team improved the AI by adding an extra algorithm to modify its gameplay decisions so they more closely resemble human strategies, while accounting for different opponent playing styles or game situations. This was achieved by training the AI on 46,000 online Diplomacy games played by humans.

The researchers organised an online tournament featuring 62 human players ranging from beginners to experts and entered two versions of the AI, each trained to respond to different types of players. The AIs were evaluated through 50 games involving one AI and six human players, with the people being aware of the AI's presence but not its identity.

46,000

The number of games used to train the AIs to play like humans

The AIs finished the tournament with the top two average game scores among those who played more than two games, and they ranked first and third among all tournament participants overall (arXiv, doi.org/jhhq).

Julian Togelius at New York University says that the results demonstrate how AIs will need to use human-like strategies to best cooperate with people. "If you have a really strong bot that plays really weirdly, it's not going to do well in the game with humans present," he says.

The version of Diplomacy in the tournament was simpler than the traditional board game, as it didn't include negotiations among players. While removing that social complexity alters the game, players still have to cooperate by taking actions such as sending armies or fleets to reinforce another player's assault on a territory. "I think we can still learn a lot about AI-human coordination and collaboration even in this very simplified version of Diplomacy," says Yannakakis.

Despite the AI's strong performance, the Meta researchers cautioned that their study doesn't definitively show that the AI can outperform the best human players. Learning the full version of Diplomacy, which includes open communication and negotiation, would pose a greater challenge.

"In the full Diplomacy game, there's a lot of 'go out into the kitchen, shake hands, look each other in the eye and phrase your words carefully'," says Togelius. ▮

AVALON HILL

In Diplomacy, players vie to control European territories

Environment

Weedkiller impairs visual learning in bumblebees

Gary Hartley

BUMBLEBEES exposed to glyphosate, the world's most popular type of weedkiller, found it harder to learn and remember colours linked to rewards – which could undermine their ability to locate food for the colony.

Marjo Helander at the University of Turku in Finland and her colleagues investigated how glyphosate, in this case in the herbicide Roundup Gold, affected buff-tailed bumblebees (*Bombus terrestris*) in colour-based learning and memory tests.

ED BROWN WILDLIFE/ALAMY

A buff-tailed bumblebee

Over five rounds, bees chose between different-coloured artificial flowers, five containing a sugar reward and five a bad-tasting quinine solution. Unexposed bees got better at finding the reward in each round. But in bees exposed to the herbicide, learning fell to effectively zero after three rounds.

In a memory test two days later, unexposed bees performed near the level they had in the fifth round of training. Meanwhile, the bees exposed to the weedkiller seemed to choose colours at random, suggesting they had retained nothing (*Science of the Total Environment*, doi.org/gq2hnv).

"Pollinators rely heavily on their visual system to be successful in their complex foraging environment," says Helander. "If this success is diminished, it will ultimately decrease the number of pollinators and thus their ability to pollinate flowering plants. That would be detrimental to both pollinator and plant populations." ▮

New Scientist Shop

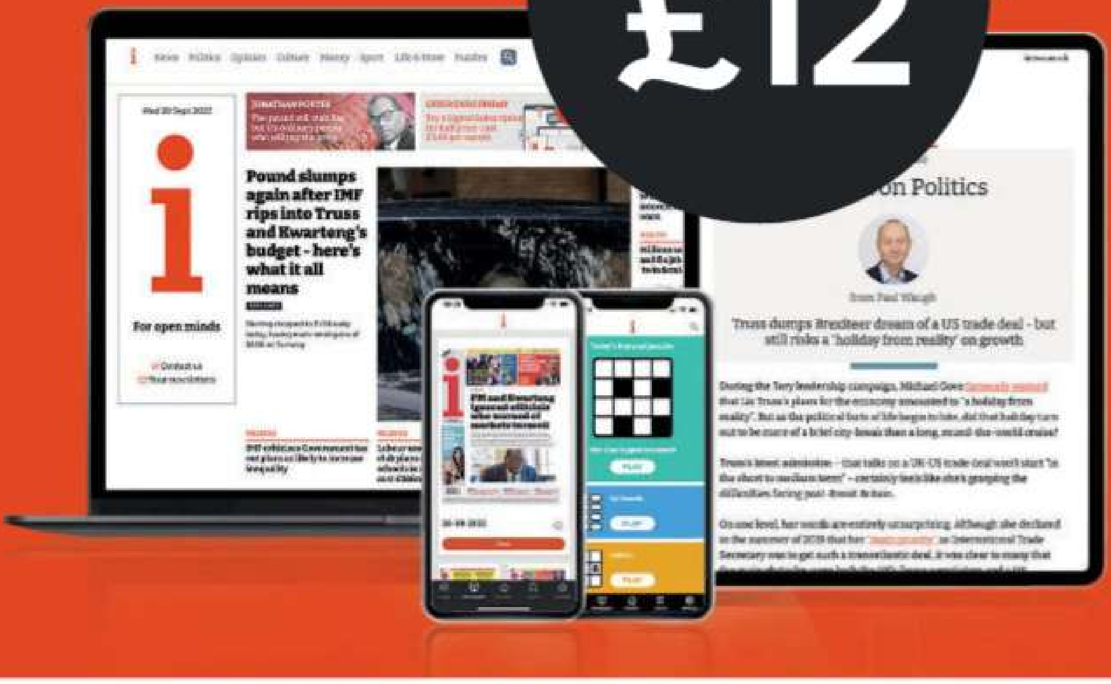
Science is my thing

Showcase your love for science with our brand new merchandise. Stay organised with our notebooks and pencil cases or brighten up your home with our tea towels and mugs. Plus, our favourite reusable tote bag is available in even more designs.

shop.newscientist.com/new

worldwide shipping available

Price shown excludes postage and packaging



LIMITED TIME OFFER

i DIGITAL SUBSCRIPTION

12 weeks for £12

Celebrating 12 years of i journalism

To find out more, visit

www.inews.co.uk/12for12

12 WEEKS £12

Get much more than news, every day

By subscribing to i you will get:

- Full access to inews.co.uk
- i news app + PDF of newspaper
- Support our journalism
- Ad-lite - 70% fewer adverts
- Subscriber-only newsletters
- Access to all i puzzles

Scan for £12 offer

T&Cs: Offer ends 30.10.22

Physics

Proton's stretchiness remains a puzzle for particle scientists

Alex Wilkins

THE proton is stretchier than we thought, according to new measurements. But physicists are divided on whether this anomaly will persist in future experiments or if our fundamental picture of the proton's structure will need to change.

Protons contain three smaller particles called quarks, which are held together by other particles called gluons, as well as very short-lived "virtual" particles. When a proton is exposed to electric and magnetic fields, these internal constituents move about according to their charge, causing the proton to deform, or stretch.

The extent to which the proton can be stretched is determined by its electric and magnetic polarisabilities, two quantities that have been measured many times and that tell us about the proton's internal structure. In 2000, an early measurement of these found that as you examine ever smaller sections of the proton, it gets briefly stretchier in response to magnetic and electric fields, before becoming stiffer, or harder to deform.

ARSCIMED/SCIENCE PHOTO LIBRARY

An artist's impression of a proton, which lurks at the heart of atoms

However, the results were imprecise and more recent experiments disagreed, finding the proton just gets stiffer as you zoom in on smaller sections – also what the standard model of particle physics predicts.

Now, Nikolaos Sparveris at Temple University in Pennsylvania and his team have measured the proton's stretchability to a higher level of precision and also found that, at certain length scales, it becomes stretchier to both electric and magnetic fields, as in the 2000 result (*Nature*, doi.org/jhgq).

"We see it with a higher precision," says Sparveris, thanks to gathering more data. "So, the ball now is on the side of the [standard model] theory."

To measure the proton's stretch, Sparveris and his team fired a beam of low-energy electrons at a liquid-hydrogen target. In their set-up, when an electron moves past a proton within the hydrogen, it produces a photon, effectively an electromagnetic field, which distorts the proton. By measuring how the electrons and protons scatter away, the team can calculate how much each proton is distorted by each photon.

While the anomalous result appears similar to the 2000 work, the size of the effect has more than halved, says Judith McGovern at the University of Manchester, UK. It is very difficult in general to measure the proton's polarisabilities at low energies with high precision, she says, and there is no obvious explanation from current theories for why it should spike as it does in the new result. "I don't think most people took [the 2000 result] really seriously, I think they assumed that it would go away, and, if I'm quite honest, I think most people will still assume that it will go away."

Different future experiments, like using a beam of positrons – the antimatter counterpart to the electron – could shed light on whether this anomaly is really there or not, says McGovern.

However, if the anomaly remains, there will have to be a revision to our understanding of the proton's structure. "Other measurements will elucidate whether or not this has an experimental origin, but it seems to be a genuine discrepancy between theory and experiment," says Juan Rojo at Vrije University Amsterdam in the Netherlands. "The question is, what does this discrepancy tell us? And, especially, what can we learn about the proton structure by understanding these things?" ▮

Technology

Robotic laser can target and kill cockroaches

RESEARCHERS have created a device that uses machine vision to spot cockroaches and zap them with a laser. They say the method could offer a cheaper and more environmentally friendly alternative to insecticides.

Ildar Rakhmatulin at Heriot-Watt University in Edinburgh, UK, and his colleagues equipped a laser with two cameras and a small computer running an AI model that can be trained to target certain types of insect.

The researchers tested several different lasers and found that a 1600-milliwatt device was able to kill a German cockroach (*Blattella germanica*) at a distance of up to 1.2 metres in around a second. These pests are commonly found in homes on all continents except Antarctica and the allergens they produce can worsen asthma and cause allergic reactions in some people.

The cockroaches were placed in a transparent box to keep them from leaving the experiment area. The insects ran at an average speed of 1.3 metres per second, but the laser tracker was able to keep up with their movement (*Oriental Insects*, doi.org/gqxf6w).

When the laser hit a cockroach's abdomen, it was killed before it could get away, but when it hit a leg first, it escaped with only slight damage. The researchers say they will need to train the AI to aim for certain parts of the cockroaches' bodies to increase the effectiveness of the system.

"The system is very cheap, even compared with pesticides, because laser prices are not so high"

Rakhmatulin says that the cost of an anti-pest laser system could be brought down to around £25, but that it will never be safe to use in residential settings because of the danger posed to human eyesight by lasers. "It's my opinion that it cannot be used for home applications," he says. "If we talk about industrial or agricultural applications, it's a very serious possibility. It's very cheap, even compared to pesticides, because laser prices are not so high." ▮

Matthew Sparkes

Solar system

Gases from asteroid are studied on Earth

FOR the first time, researchers are analysing pristine gases from an asteroid. These were collected by Japan's Hayabusa 2 spacecraft, which visited the asteroid Ryugu from 2018 through 2019.

Ryugu probably formed near the edge of our solar system before being flung towards Earth. To find out more, researchers examined gases from rock samples. These gases indicate how long Ryugu's surface has been exposed to space radiation – about 5 million years, according to the new analysis.

That is consistent with asteroids near Earth, not in the outer solar system, so Ryugu must have migrated inwards from its birthplace at least millions of years ago (*Science Advances*, DOI: 10.1126/sciadv.add8141 and DOI: 10.1126/sciadv.abo7239; *Science*, doi.org/jhkp). **Leah Crane**

LEE ET AL., SCI. ROBOT. 7, EABQ7278 (2022)

Health

Gut bacterium eases liver disease in mice

ALTERING the gut microbiome could help reduce the harmful effects of nicotine on the liver.

Previous studies suggest that smoking tobacco or using nicotine patches can lead to a build-up of nicotine in the gut, which has been linked to more severe non-alcoholic fatty liver disease.

Now, research by Frank Gonzalez and Lulu Sun at the National Institutes of Health in Maryland and their team has found that a gut bacterium that degrades nicotine can reduce the severity of this condition in mice. The team identified a species of bacterium called *Bacteroides xylanisolvens* that degrades nicotine using an enzyme called NicX (*Nature*, doi.org/gq3kvb).

Sun suggests that a probiotic containing the enzyme could be developed for use in people. **Carissa Wong**

Technology

Physical neural net could make aircraft wings that morph

A MECHANICAL neural network composed of beams, motors and sensors can learn to carry out several different tasks, just like its software equivalent, and could lead to aircraft wings that change shape during flight to maintain efficiency or minimise turbulence.

Modern AI research relies on artificial neural networks (ANNs), which mimic brain structure by creating grids of artificial neurons connected by synapses. Just as the human brain learns new behaviours by bolstering synaptic connections, ANNs learn by adjusting the digital values stored to represent them.

Ryan Lee at the University of California, Los Angeles, and his team borrowed that concept to create a mechanical neural network in which the strength of connections between neurons is replaced by beams of variable stiffness.

Instead of processing digital data, the mechanical version processes forces applied to it, twisting and morphing its shape depending on the stiffness of its beams.

The team built a network of 21 beams, each 15 centimetres long and arranged in a triangular grid (pictured). Every beam has a small linear motor that can alter stiffness, plus sensors that measure how far each "neuron", or beam joint, is out of position. This allows a computer to train the network by tweaking beam stiffness. Once this is done, the structure requires no external computation and the beam stiffnesses are locked in (*Science Robotics*, doi.org/gq3jvs).

Lee says that an aircraft wing with a mechanical neural network could automatically morph in response to situations, for example to prevent undesirable reactions to turbulence. **Matthew Sparkes**

Really brief

GPOINTSTUDIO/CULTURA CREATIVE RF/ALAMY

Smartphone data can show death risk

Data from just 6 minutes of walking, collected by smartphone sensors, may be enough to predict a person's risk of dying in the next five years, according to information on 100,655 people in the UK Biobank study. Participants wore motion sensors for one week (*PLoS Digital Health*, doi.org/jhkc).

Hair follicles grown in lab for first time

Mature hair follicles have been grown using mouse tissue in a lab for the first time – a move that could one day treat hair loss. The follicles reached up to 3 millimetres long. The team is now working to recreate the experiment using human cells (*Science Advances*, DOI: 10.1126/sciadv.add4603).

One chip transmits all internet traffic

A single computer chip has transmitted a record 1.84 petabits of data per second via a fibre-optic cable. That is enough bandwidth to download 230 million photographs in that time, and more traffic than travels through the entire internet's backbone network per second (*Nature*, doi.org/jhks).

New Scientist
Discovery
Tours

7 June 2023

13 days for £9345 per person

Science of the Arctic cruise: Svalbard, Norway

Experience the realm of the polar bear and the midnight sun with experts onboard a marine expedition ship

Join us as we explore the northernmost region of Earth by sea. Gain extensive knowledge of marine and polar nature while deepening your connection to this remote and rugged archipelago.

Witness polar bears on ice flows (June is one of the best months to spot them), beluga whales and a plethora of species on land, in the sea and in the air.

Aboard a new state-of-the-art polar expedition vessel, the Greg Mortimer, you will experience the majesty of Norway's Svalbard region with its ancient glaciers, glass-still fjords, imposing pack ice and distinct landscape where wildlife thrives at nearly 80° north.

The trip includes a full programme of talks, shore visits and Zodiac boat safaris. You will be accompanied by marine biologist and author Helen Scales as well as a highly knowledgeable expedition team, experts in exploration, science and wildlife.

Highlights

- Venture close to 80° north, searching for polar bears on pack ice.
- Discover the thrill of seeing creatures such as walruses, seals, whales, reindeer, arctic foxes, guillemots and puffins.
- Cruise along blue glacier fronts and through stunning fjords on a purpose-built intimate polar expedition ship.
- Enjoy tundra hikes amid stunningly beautiful scenery.
- Hear fascinating talks from marine biologist Helen Scales and the polar expedition team.
- Embark on daily Zodiac boat safaris exploring fjords and glaciers.

Scan me to find out more

In partnership with Polar Routes and Aurora Expeditions

POLAR ROUTES aurora expeditions

To book, call UK +44 (0)203 196 1000 (Mon-Fri 9am to 5:30pm, Sat 12pm to 4pm GMT)
Or email info@polarroutes.co.uk

SAVE 33% WITH A SERIES TICKET*

New Scientist
Events

ONLINE EVENT
BIG THINKERS SERIES

VERONICA O’KEANE
MEMORY, THE BRAIN AND WHO WE ARE

Thursday 10 November 2022
6-7pm GMT, 1-2pm EST and on demand

How do our brains store and then conjure up past experiences to make us who we are? Why can memories feel so real? Are there such things as “true” and “false” memories?

In this talk, psychiatrist Veronica O’Keane will draw examples of the broken memories of psychosis to illuminate the integrated human brain, offering a new way of thinking about our own personal experiences.

For more information and to book your place, visit
newscientist.com/brainandmemory

ALSO IN THE SERIES

THE ORIGIN OF THE UNIVERSE
WILL KINNEY

REALITY+: FROM THE MATRIX TO THE METAVERSE
DAVID CHALMERS

WHAT WE DON’T KNOW ABOUT GRAVITY
CLAUDIA DE RHAM

PHYSICS AT THE END OF THE UNIVERSE
KATIE MACK

A BRIEF HISTORY OF TIMEKEEPING
CHAD ORZEL

FANTASTIC NUMBERS AND WHERE TO FIND THEM
TONY PADILLA

SPACE, TIME AND MOTION
SEAN CARROLL

*saving based on individual ticket prices.

BIG THINKERS SERIES
VERONICA O’KEANE

The columnist
Chanda Prescod-Weinstein on James Webb's legacy p28

Aperture
Researchers unveil the world's largest digital camera p30

Letters
Condolences and thoughts on green funerals p32

Culture
The Blaze reveals the turmoil and tragedy of wildfires p34

Culture columnist
Simon Ings peers inside the lonely future of *Remote* p36

Comment

Seeing red

We have projected our hopes and fears onto Mars through the ages. Even today, the Red Planet still spells adventure, says **Stuart Clark**

THERE is something about Mars that captivates us. Throughout history, different cultures and individuals have looked at the blood-red beacon in the night sky and filled it with whatever their imaginations associated with the unknown. Across time, Mars has been the celestial embodiment of warrior gods, an astrological talisman of spiritual influence, a venue for utopia and the wellspring of horrors beyond belief. Even today, our relationship with the Red Planet continues to evolve.

Of the five planets that are visible to the naked eye, Mars is easily the most dramatic, and its observable behaviours have informed our cultural interpretations of it. Yet from the flighty apparition of Mercury in the twilight to the extraordinary beauty of Venus in the gathering evening, the unflinching progress of Jupiter and the laboured march of yellowed Saturn, Mars has stiff competition. Still, it stands out for two reasons.

MICHELLE D'URBANO

The first is its baleful red colour. The second is that it is the only planet that appears to wax and wane significantly in brightness. Sometimes it is an unmistakeable beacon, strangely daunting and burning brightly. At other times, it is so faint that it fades to the point of obscurity against the stars.

Perhaps it is these comings and goings that have piqued our curiosity through the ages, inviting us to speculate. In his book *The Structure and Dynamics of the Psyche*, published in 1960, noted psychiatrist Carl Jung wrote: "The starry vault of heaven is in truth the open book of cosmic projection." He believed that when we look at celestial objects, we can't help but project our innate hopes and fears onto them.

Indeed, Mars has proven itself to be the perfect venue for such projection, as the vast library of stories set on the Red Planet can attest. Yet these works aren't wholly flights of fancy. The imaginations of writers like H. G. Wells, Ray Bradbury and Arthur C. Clarke were fed by the leading scientific investigations of their age.

The late-19th century was a particularly fertile time for interest in Mars. Telescopes were just starting to resolve the planet's surface features, but, due to a strange quirk of human cognition, our brains joined these half-glimpsed landmarks into straight lines. This led to the idea that Mars was a dying planet, with its supposed inhabitants digging canals in a desperate attempt to irrigate the deserts.

So widespread was the belief in Martian life that, in 1891, when Anne Goguet established a prize of 100,000 francs in the name of her son, Pierre Guzman, to be awarded to the first person to communicate with extraterrestrials, Martians were excluded from consideration on the grounds that talking to them would be too easy. Despite the canals being thoroughly debunked in the early decades of the 20th century, they continued to be a motif in fiction until the second half of the century.

These days, we continue to shroud the planet in our hopes and fears. For evidence, look no further than the discussions around Elon Musk's aim to colonise Mars. And, while a view of the planet is lost to so many of us because we live in light-polluted areas, our mental image of Mars is perhaps more vivid than at any other time in history. Thanks to space exploration and the internet, many of us can be on Mars at the click of a mouse.

But why has Mars endured above all other planets in the public consciousness? I believe it is because the more we discover about it, the better it becomes. It is a world composed of larger-than-life versions of Earth's most exciting landscapes. Mars has taller volcanoes, deeper canyons, colder deserts and larger dust storms. Everything about it spells adventure – and that is irresistible to us. ▮

Stuart Clark is a consultant for *New Scientist* and editor of the upcoming *The Book of Mars*

Field notes from space-time

Cosmic challenges The extraordinary James Webb Space Telescope, named after a man whose legacy I deplore, represents the contradictions of my job, says **Chanda Prescod-Weinstein**

Chanda Prescod-Weinstein is an assistant professor of physics and astronomy, and a core faculty member in women's studies at the University of New Hampshire. Her research in theoretical physics focuses on cosmology, neutron stars and particles beyond the standard model

LAST Christmas, I woke early in the morning, which is unusual for me. Not only am I a practising Jew, but it has been a few decades since I was a kid in the household of my non-Jewish parent, waking up eager for gifts. But Christmas 2021 was different. NASA – in partnership with the European Space Agency and other organisations – was launching the next in its series of Great Observatories. I was up early because I wanted to watch and because I was nervous as hell: what if it blew up during launch?

The final price tag for the instrument NASA calls the James Webb Space Telescope (JWST) was $10 billion. This sounds like a literally astronomical sum of money, but to situate it in context: Disney's Marvel Cinematic Universe films have grossed almost three times this amount in less than the decades invested in JWST. Even so, $10 billion might be relatively small compared with the annual US Department of Defense budget (which is 194 times bigger), but to us in the astronomy community, it is a big number that has drawn bad press over the years.

Importantly, one reason why this was such an expensive facility is because it was hard to build. I will spend my life telling anyone who will listen that JWST is an extraordinary feat of human ingenuity. A telescope designed to look deep into space using infrared – wavelengths just beyond those the human eye can see – via the biggest mirror ever launched into space faced a number of technical challenges. The most obvious one: how to get the mirror up there?

The incredible solution was to make a segmented mirror that could be folded for the journey to space and that would unfold, unassisted, once it arrived at its destination. So, an explosion at launch wasn't the only incident we had to fear. JWST had 344 single-point failures: items and systems that had to work in order for the instrument to succeed in its endeavour. Developing and testing an instrument that was robust against these risks wasn't cheap, nor was it easy. I don't envy the scientists who faced intense pressure, knowing that if this didn't work out, the US Congress might never allow the astronomy community another facility like it.

That morning, I was full of another set of complicated feelings too: JWST was going up with the name James Webb attached to it, despite an effort to remove it that I had led with other astronomers. Webb not only played a major role in promoting psychological warfare as a cold war tactic during his time at the US Department of State, but played a part in the early stages of the lavender scare, an anti-LGBTQ+ moral panic. He went on to serve as NASA administrator during the storied Apollo era. Webb presided over an increase in non-openly LGBTQ+ Black staff at NASA. At the same time, a NASA employee named Clifford Norton was extrajudicially interrogated by NASA's head of security, on suspicion that he was gay, and then fired for it.

> **"I have coined the phrase 'Just Wonderful Space Telescope' as an alternative name for JWST"**

As administrator, Webb was, at the very least, complicit in a status quo where queer Black people like me could never have a home in the NASA community. JWST is the greatest telescope humanity has ever built. As I argued with comrades in *Scientific American* last year, why not name it for someone truly worthy of admiration, like Harriet Tubman, an anti-slavery war hero who probably used the stars to navigate herself to freedom?

It is hard to talk about the telescope when using its name means treating it as a monument to a man who stood in the way of freedom for people like me. I have navigated this by coining the phrase "Just Wonderful Space Telescope", which, since my September 2021 tweet about it was published in *The New York Times*, has made its way into the world as an alternative name. There were other complications: JWST was built by defence contractors, which stand for everything I am against.

The telescope has, in some ways, come to represent the contradictions of my profession. But rather than take a stand against doing this kind of science, JWST motivates me to keep pushing for a scientific community organised around the value of investing in and caring for people, including nurturing our sense of wonder.

In July, the first image from JWST was unveiled: the initial deep field, which used a long exposure time to capture even the faintest objects in a small patch of sky. This one image contained thousands of galaxies, some of which are probably 13 billion years old – almost as old as the universe itself. Many of the galaxies' images were quite visibly distorted by gravitational lensing, suggesting the presence of dark matter. I don't know if I have ever seen a more beautiful snapshot of the cosmos in my life.

The cosmic lesson for me: the fight to gather this information in an ethical way is worth it. ▮

Chanda's week

What I'm reading

I have been enjoying PM Press's new illustrated edition of Peter Kropotkin's Mutual Aid: An illuminated factor of evolution, *illustrated by N. O. Bonzo.*

What I'm watching

I have finally managed to see all of the Alien movies.

What I'm working on

I am preparing to teach a PhD course on quantum mechanics this coming spring.

This column appears monthly. Up next week: Graham Lawton

New Scientist Newsletter

Launchpad

Voyage across the galaxy and beyond with our weekly space newsletter

A new era of space travel has officially begun. Let our resident space expert Leah Crane fill you in on all the very latest news on our exploration of the solar system – and beyond.

Every week, she'll send you awe-inspiring pictures, cool facts and all the space stories we publish on newscientist.com, in addition to some stories that you won't be able to read anywhere else.

Sign up to the Launchpad newsletter and join the conversation about space.
newscientist.com/launchpad

Leah Crane

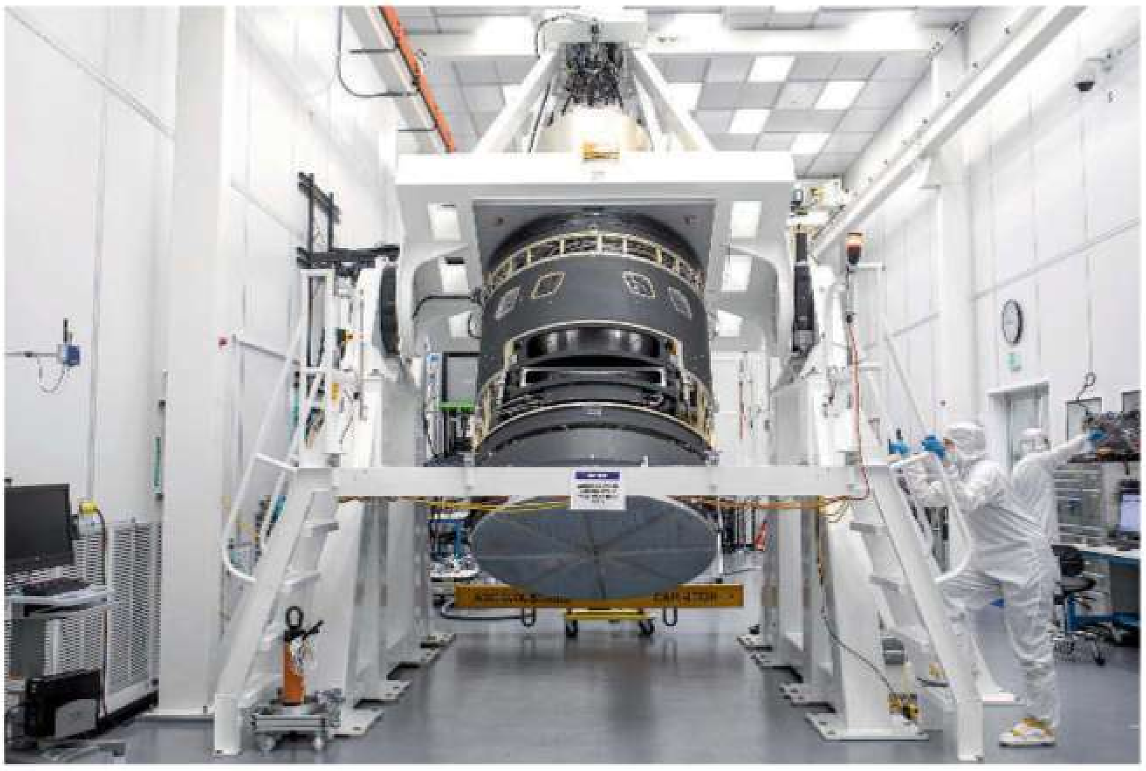
Scan me to sign up

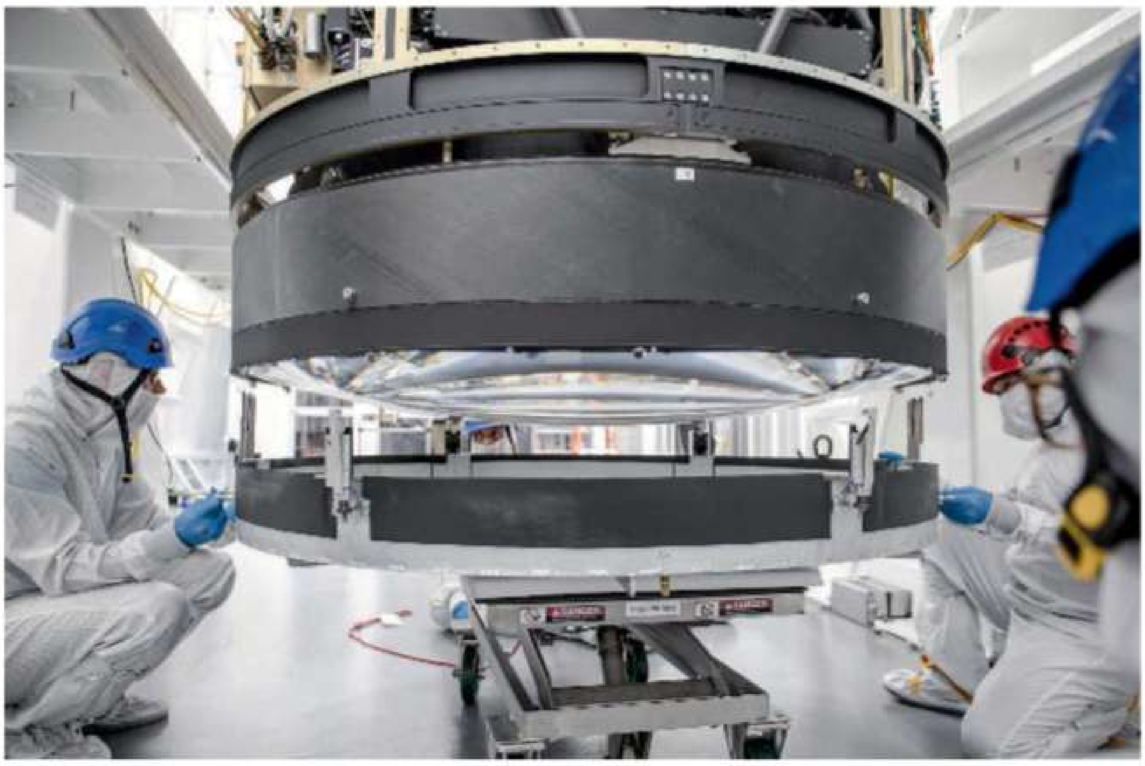
Our family of newsletters

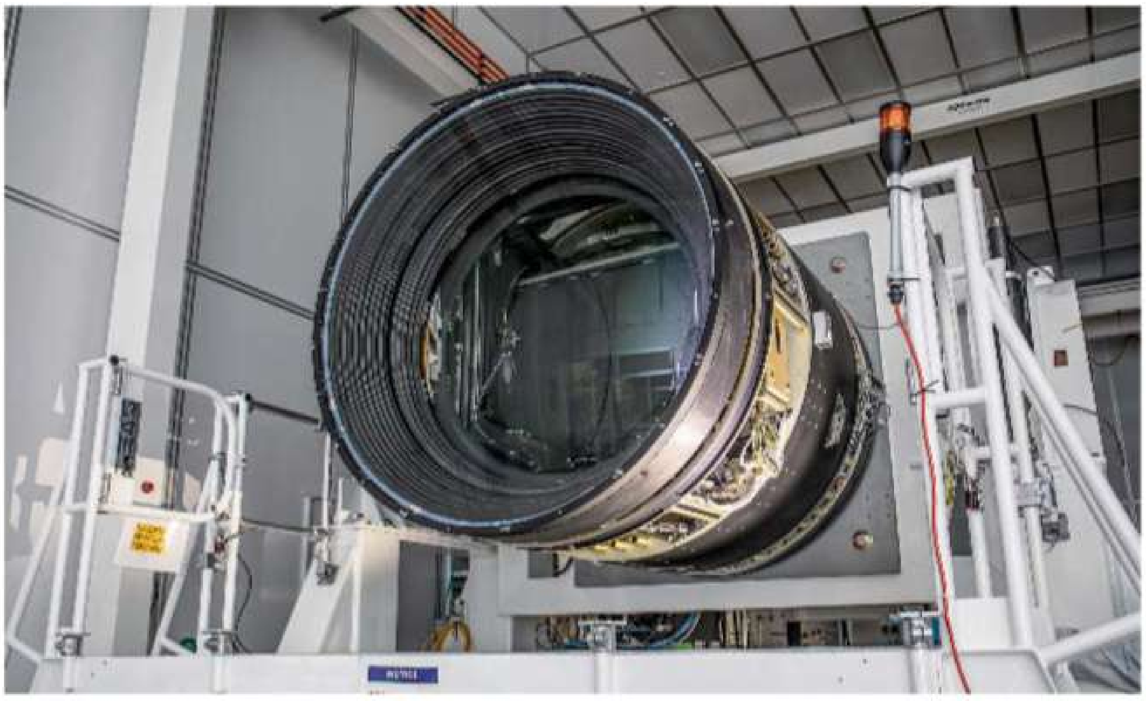
newscientist.com/newsletter

The Weekly
The Daily
Fix The Planet
Health Check
Launchpad
Lost in Space-time
Our Human Story
Wild Wild Life

NO ENTRY
WITHOUT
LOCK-OUT







Record breaker

Photographer **Jacqueline Ramseyer Orrell, SLAC National Accelerator Laboratory**

STANDING at 1.65 metres tall, the world's largest digital camera has been unveiled at SLAC National Accelerator Laboratory in California.

At the end of 2024, it will be installed at the Vera C. Rubin Observatory on the summit of Cerro Pachón in Chile. In its home in the Andes mountains, it will catalogue about 20 billion galaxies over the next 10 years as part of a project called the Legacy Survey of Space and Time (LSST). The 15 terabytes of data that the LSST Camera will collect every night will advance our knowledge of the universe, helping researchers unpack the nature of mysterious dark matter and better understand how galaxies are formed.

The LSST Camera works like any other digital camera, but it is much bigger. Its 189 sensors take in light emanating from objects like stars and convert it to electrical signals that can be turned into digital images. Each sensor is a square with sides 42 millimetres long and packs more pixels than the camera on an iPhone 13. In total, the camera has 3.2 gigapixels and will take images with a resolution high enough to see a golf ball from 24 kilometres away. Its biggest lens, with a diameter of 1.57 metres, is the largest of its kind ever made.

The top left image peers through the camera's outermost lens, revealing the blue "mosaic" arrangement of the 189 sensors. At right, the top and middle images show the camera with a cap covering the lens. The bottom images show the camera's 3-tonne body (left and right) and researchers wearing protective attire to avoid contaminating the camera's electronics (middle). ▮

Karmela Padavic-Callaghan

Editor's pick

Condolences and green funeral suggestions

8 October, p 24

From Helen Gould, Saratoga, New South Wales, Australia

Graham Lawton, we feel something of your loss of your beloved wife Clare; our hearts go out to you.

On the subject of green funerals, my husband was a co-editor of the book *Biochar for Environmental Management* and says one good option is to pyrolyse a body to turn it into charcoal. That is what I want to happen to my remains.

I hope that, after my funeral and when my biocharred body has cooled down, my friends will take some charcoal home to use in their garden soil. This will help store carbon away from the atmosphere and build soil health.

From Stephen Lismore, Sheffield, UK

I was immensely moved by Graham's farewell to his wife Clare. So sorry for your loss, Graham, and for the terrible condition Clare faced. I was also so impressed that Graham could find the science behind this personal tragedy.

I, too, would like a green, woodland burial. Even though I hope it is a way off, I will start looking for a site. One may be easier to find where I live than in London, but they still aren't nearly available enough.

From Andrew Shead, Tulsa, Oklahoma, US

A good alternative to a regular burial, green burial or cremation is natural organic reduction. This digests bodies to create a nutrient-dense soil to enrich conservation land, forests or gardens.

Leaked gas should have been allowed to burn

22 October, p 19

From Charlie Wartnaby, Cambridge, UK

I hope we never see anything like the Nord Stream gas pipeline leaks again. But if we do, I suspect that even uncontrolled partial burning would be better climate-wise than a release of pure natural gas. It should have been ignited.

Could US-style headgear protect against dementia?

15 October, p 19

From Talia Morris, Cape Tribulation, Queensland, Australia

You report that international rugby union players face a higher risk of dementia than the general population. This may be naive, but it seems to me that the risk of brain injury in rugby players could be greatly reduced by requiring them to wear protective helmets, as they do in American football.

Call off the return to the moon at our peril

Letters, 1 October

From Stephen Markham, Adelaide, South Australia

Some letters have suggested that space exploration of various types shouldn't go ahead for financial or environmental reasons.

There may be consequences to reducing NASA's remit that would make these aims futile. For one, the threat of unemployment for scientists and engineers. A country with ambitions for a crewed space programme could offer specialists attractive packages to relocate and train others in all aspects of space science and engineering.

And would private space firms stop their activities if clients like NASA and the European Space Agency were being starved of funds? They could open branch offices in countries that couldn't afford their own space programme, but that would love to have a high-tech industry partly based there. These companies could then seek clients, ranging from governments to commercial enterprises, without facing the restrictions their former nations might have imposed on them.

Worries remain about genetically modified seed

15 October, p 51

From Graeme Hurry, Preston, Lancashire, UK

I read with interest Clare Wilson's article on the genetic engineering of food, centred on her desire to acquire seeds from genetically modified purple tomatoes.

I am sure modified farmed foods are safe. However, I worry that GM seed companies might one day include a terminator gene in engineered varieties that would make seeds harvested from the crop "ungrowable", so more seed has to be bought each year. Could this genetic code somehow get into non-GM crops?

If so, all crops could lose the ability to self-generate from year to year. In disaster situations in which monopolistic GM firms disappeared or raised prices drastically, millions could starve.

That chance helps shape us is no big surprise

24 September, p 36

From Sam Edge, Ringwood, Hampshire, UK

I don't understand why anyone would be surprised that a significant part of our variability, especially in brain function, is down to chance.

Our DNA has about 3 billion base pairs, each of which encodes two bits of data. Even if all of this were significant, that isn't enough data to exactly describe the details of even a small part of a person's brain structure and connectivity, let alone their whole body.

There are already a number of human attributes known to be at least partially random, such as fingerprints and iris and retina patterns, to name just a few. Considering how our bodies and brains form, and how they wire themselves up, it would be impossible for these structures to be entirely determined genetically.

Magnetism could also explain space mysteries

8 October, p 34

From Ed Prior, Poquoson, Virginia, US

Stuart Clark's excellent article "Our magnetic universe" stated that nuclear fusion "relies on strong magnetic fields to trap energy and heat" and that this "unexpected ability of the [galactic] magnetic fields to trap heat could solve the puzzle of the inexplicably hot intracluster medium in galaxy clusters". This is consistent with ideas that the magnetic fields near our sun's surface are trapping heat and causing the solar atmosphere to rise to temperatures of millions of degrees, while the sun's surface is only in the thousands – this is still a mystery.

One idea for why jabs cut risk of long covid

8 October, p 12

From Stephanie Woodcock, Carnon Downs, Cornwall, UK

Michael Edelstein wonders why vaccination reduces symptoms of long covid. Could it be that long covid occurs because a bad bout of covid-19 occupies the immune system to such a degree that an underlying infection can manifest? If so, would it be worth asking what kind of latent infection could behave like this?

Findings suggest that the vaccine might cushion the toll covid-19 takes on the body. This might leave many people with a greater immune capacity to resist severe long covid developing.

Want to get in touch?

Send letters to letters@newscientist.com; see terms at newscientist.com/letters

Letters sent to New Scientist, Northcliffe House, 2 Derry Street, London W8 5TT will be delayed

New Scientist
Subscriptions

GIFT SUBSCRIPTIONS
FROM JUST £49.50
+ FREE GIFTS WORTH OVER £40!

92 **U** Uranium	7 **N** Nitrogen	74 **W** Tungsten	88 **Ra** Radium	15 **P** Phosphorus

Show friends and family how much you care this Christmas by unwrapping the wonders of science with a *New Scientist* gift subscription.

EARLY BIRD OFFER
FREE
BAG FULL OF SCIENCE

OFFER MUST END
9 NOV 2022

As part of our early bird offer, we're giving away a limited number of free bags full of science with all *New Scientist* subscriptions when bought as a gift. These include a *New Scientist* tote bag and three issues of our Essential Guide series – worth over £40!*

To find out more, visit
newscientist.com/18812
Or call +44 (0) 330 333 9470, quoting 18812

*Free gift available in UK, US, Canada, New Zealand and Europe only on all gift subscription options. Free gift-boxed issue available on UK 'digital and print' gift subscriptions only. Gifts are subject to availability. Prices start from £49.50 for web subscriptions. Other packages are also included in the offer. The gift-giver will be sent the gift-boxed issue by 16th December to give to the recipient. This will enable you to meet the last Christmas post deadline if you wish to post the gift box on to the recipient within the UK. In the unlikely event that you wish to cancel your subscription, we offer a 14-day cooling off period after initial payment is made. Early bird offer ends 9th November 2022.

Out of the inferno

The wildfires that cut swathes across Europe this year resonate in a taut, realistic story of a father and son fleeing a local blaze, says **Katie Smith-Wong**

Film

The Blaze (En Plein Feu)

Quentin Reynaud

Release pending

MARIE-CAMILLE ORLANDO

André Dussollier and Alex Lutz play a father and son escaping from a wildfire

THIS summer, France recorded more wildfires than ever before, with over 62,000 hectares destroyed by 20 August. Since January, the area hit by wildfires in France is 7.5 times greater than the annual average of the 15 years up to 2021, with one huge fire near Bordeaux forcing 10,000 residents to flee.

The Blaze (*En Plein Feu*), a French film that debuted at the London Film Festival earlier this month, is clearly a case of art imitating life. Directed by Quentin Reynaud and starring André Dussollier as Joseph, and Alex Lutz as his son, Simon, it focuses on how the pair try to escape the ever increasing threat of a wildfire, overcoming many obstacles as they make their way to the coast.

The film was shot before the recent French fires, and was inspired by California's Camp Fire in 2018, the deadliest wildfire in the history of the US state. Its straightforward premise allows the narrative to focus on the protagonists' survival.

Reynaud avoids Hollywood disaster hype, opting not to glamorise the plot with special effects and ambitious action scenes. Instead, he takes the route of realism and captures authentic emotions through a taut screenplay and simple, subtly effective direction.

During the film, we see local people prepare for evacuation, listen to and act on warnings, and (unsurprisingly) run and panic – nobody is trying to be a hero here, which adds to the realism.

Reynaud focuses on the emotional turmoil of his characters and their need to not only get through a growing wildfire, but also face up to the possibility of dying.

While the protagonists follow the evacuation protocol, they are never complacent: their fear of the wildfire getting out of control is an ever-present possibility, especially as they witness its devastating effects on local wildlife. This detail steadily raises the film's tension, especially as we feel the hope dwindling as time is increasingly against them.

As Simon, Lutz brilliantly captures the desperation of trying to survive with an expressive performance and quiet determination. Dussollier brings an extra layer of complexity – and extra pressure as Joseph's arthritis becomes more of an issue than anticipated.

The escape takes centre stage, but there are flashbacks to expand Simon's back story, as well as the initial steps and precautions around mass evacuations. They initially seem redundant, but their significance becomes apparent as Simon's need to survive grows.

Reynaud allows the natural dangers of wildfire and the perilous journey of his characters to drive this tense, emotionally charged eco-disaster thriller. In other hands, it could have been a disaster of a different kind. ▮

Katie Smith-Wong is a film critic based in London

The safari just outside your office

Podcast

BBC Earth Podcast

BBC Studios Natural History Unit

YouTube and major platforms

"WHEN I was a child, I got chased by a warthog." With this unlikely holiday story from Botswana, co-host Rutendo Shackleton begins *Safari*, the first episode of a new season of the *BBC Earth Podcast*, an exploration of the natural world for those who may not be quite as confident navigating it.

A creation of the BBC Studios Natural History Unit, it is a conversational, slickly produced podcast that seeks to engage more than it informs. Yet it does both effectively, prompting the listener to take a closer look at whatever nature is near them.

Safari invites city folk to view their immediate surroundings with the same curiosity and wonder with which they might look for lions, leopards, rhinos elephants and African buffalo in South Africa.

Zoologist Shackleton shares hosting with New York-based scientist Sebastian Echeverri in this magazine-style podcast, which is aimed at people whose worlds might not extend far beyond the city limits.

If Echeverri's US enthusiasm grates a little at first to an English ear, it does prove quite infectious. Equally infectious is Lucy Lapwing, somewhat undersold as a "nature Instagrammer", who gives listeners a friendly, knowledgeable tour of the temperate rainforest on the Isle of Bute in Scotland, UK.

From the full-bodied sound design to Lapwing's evocative descriptions of all she sees, smells and hears, you feel you are there with her – encouraged, by her example, to pay attention to your closest patch of green, even if it is just outside your office. ▮

Elle Hunt

Clear and present emissions

While the US military appears to take climate change seriously, it is a major polluter. **James Dinneen** explores an exposé of the pentagon's bad habits

Book

The Pentagon, Climate Change, and War
Neta C. Crawford
MIT Press

IN JUNE, the secretary-general of NATO announced that the military alliance would reduce its greenhouse gas emissions to net zero by 2050. As the website *Energy Monitor* reported, observers objected to important details being left vague, such as which countries it covered.

Since the first international climate summit, military emissions have been largely exempt from reporting and reduction targets. It is time this changed, says Neta Crawford, an international relations expert at the University of Oxford.

In her new book, *The Pentagon, Climate Change, and War: Charting the rise and fall of US military emissions*, she puts numbers to the emissions produced by NATO's largest member, the US military. Using only publicly available sources, she finds that in 2019 the US military and its manufacturers were responsible for emissions equivalent to 105.7 million tonnes of carbon dioxide. The official number cited is about half that.

Crawford's estimate includes fuel for jets, ships, tanks and electricity used in global bases. It also includes emissions from weapons manufacturing and its supply chains. Crawford omits trickier emissions, those generated by US operations resulting in burning buildings or bombed fossil fuel infrastructure, or rival powers aiming to match US military might.

"The US Department of Defense is the largest single institutional emitter of greenhouse gases in the world"

Even incomplete, the figures show that the US Department of Defense (DoD) is the largest single institutional emitter of greenhouse gases in the world, contributing more than the 45 lowest-emitting countries combined. That is tiny compared with total US emissions – less than 1 per cent – but military emissions are larger than the sum of their gigatons. "Military demand for fossil fuels has been and continues to be a key driver for the adoption of fossil fuels," Crawford writes.

Her steady narration traces the history of the US military through its increasing dependence on fossil fuels, and its efforts to secure them. The Navy's transition in the 19th century from sail-powered ships to those powered by coal was the first major shift.

The US military used more coal than oil until just after the second world war, when petroleum became its lifeblood, powering ships, land vehicles and planes. As with coal, securing the military's access to oil shaped US strategy, influencing the location of bases and driving measures to protect access to oil, especially in the Persian Gulf.

According to the DoD, US military emissions peaked during the Gulf war at around 110 million tonnes. The decrease since then is mostly due to energy efficiency, switching ships to natural gas and nuclear power, and closing bases.

The great irony is that the DoD has been among the loudest voices in federal government on climate change, recognising threats such as bases flooding or the melting of Arctic ice making submarines easier to detect. It has also grasped that climate change may lead to conflict.

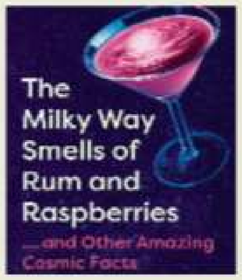
Because the DoD assumes the worst effects of climate change are inevitable, Crawford writes, it has backed adaptation over solving the problem. Fossil fuels are so integral to the US military it is hard to see how this history could have been much different.

But Crawford convinces us that US military emissions should be accounted for like any others and that it should work harder to cut them, not just for the planet, but to shed a dependency dating back to the US civil war, which still shapes domestic energy policy today.

After the second world war, petroleum overtook coal in powering US Navy ships

STOCKTREK IMAGES, INC./ALAMY

Don't miss


The Milky Way Smells of Rum and Raspberries
...and Other Amazing Cosmic Facts

Read

The Milky Way Smells of Rum and Raspberries writes astrophysicist Jillian Scudder. Her offbeat tour of the universe, with its weird and wonderful facts, will have us looking at the night sky afresh. On sale 3 November.

Watch

Manifest's fourth season continues the uncanny story of airline passengers who landed five years too late. It stars Josh Dallas and Melissa Roxburgh as Ben and Michaela Stone (pictured). The first half of the season comes to Netflix on 4 November.

Visit

The Pluto Story is astronomer Ian Robson's tale of Pluto's demotion from planet to dwarf planet. Robson's talk will be at Augustine United Church, Edinburgh, UK, and livestreamed on YouTube at 7.30pm GMT on 4 November.

MIDDLE: PETER KRAMER/NETFLIX; BOTTOM: NASA/JHUAPL

The film column

Staying in

An architect who never leaves her desirable, if lonely, flat notices a clock running backwards and other oddities in her slick world. *Remote* explores the deep feeling under the surface of teched-up, consumerist lives, says **Simon Ings**

Simon Ings is a novelist and science writer. Follow him on Instagram @simon_ings

HAUSER & WIRTH

Unoaku (Okwui Okpokwasili) is adrift in her flat

Film

Remote

Mika Rottenberg and Mahyad Tousi

On limited release

FROM her high-rise in a future Kuala Lumpur, where goods flow freely, drone-propelled, while people stay in their apartments, Unoaku – in a brilliant, almost voiceless performance by Okwui Okpokwasili – ekes out her life.

There are herbs on her windowsill and vegetables growing in hydroponic cabinets built into her walls. If she is feeling lazy, a drone will deliver a meal that she can simply drop, box and all, into boiling water. Unoaku's is a world of edible packaging, smart architecture, living rugs that she spritzes daily – and profound loneliness. She lives by herself, and so does everybody else.

Though *Remote* was filmed during the covid-19 lockdowns, it would be a mistake to consider it just another "lockdown movie". Unoaku's world is by no stretch a world in crisis, still less a dystopia. Her vibrant apartment – I want her wallpaper and so will you – is more refuge than prison. Its walls move to accommodate Unoaku, giving her at least the illusion of space. If it hadn't been for the covid-19 pandemic, we might well be viewing this woman's life as a relatively positive metaphor for what it would be like on a long space journey. One imagines lunar or Martian terraformers settling for much less.

Hers is, however, a little life: reduced to self-care, to hours gesturing at a blank wall – she is an architect, working in virtual reality – and to evenings in front of *Eun-ji and Soju*, a Korean dog-grooming TV show. Soju is the terrier and Eun-ji (Joony Kim) is its ebullient owner.

> "*Remote* is that rare thing, an 'art movie'. It belongs to a genre that streaming has made unviable"

Things start to go very slightly wrong. Unoaku's pan is returned dirty from the cleaning service. Eun-ji turns up drunk to her live show. Unoaku notices the goofy clock on Eun-ji's wall has started to run backwards. When she points this out on the programme's chat platform, she triggers a stream of contempt from other viewers.

Unoaku is far more fragile than we thought. Now, when she leans out of her window, bashing her cooking pan with a wooden spoon, celebrating, well, something – maybe just the fact of being alive and able to hear other human beings – she is left shaking, her face wet with tears.

Soon, other women contact her. They, too, have been watching *Eun-ji and Soju*. They, too, can see the clock going backwards on the dog groomer's wall. Bit by bit, a kind of community emerges.

Commissioned by UK non-profit organisation Artangel and a consortium of international galleries, *Remote* is that rare thing, an "art movie". It belongs to a genre streaming has made economically unviable and that has been largely forgotten.

Mika Rottenberg, one of two co-directors, is an artist working in upstate New York, best known for short, cryptic video works, such as *Sneeze*, in which well-dressed men with throbbing noses sneeze out steaks, light bulbs and live rabbits. The other director, Mahyad Tousi, has a more traditional background: he was an executive producer on CBS comedy *United States of Al*, and is now writing a sci-fi adaptation of *One Thousand and One Nights*.

We can't expect *Remote* to revive the art movie overnight, of course, but it offers an excellent argument for making the attempt. Like a modern Japanese or Korean short story, *Remote* explores the tiny bounds of an ordinary-seeming urban life, hemmed in by technology and consumption, and it surprises with a world of deep feeling that is bubbling just beneath the surface. ▮

Simon also recommends...

Book

Tomorrow's Parties

Jonathan Strahan

MIT Press

Have-nots turn garbage islands into Kowloon-like autonomous zones after stealing from delivery drones. This is just one of 10 sci-fi stories in this anthology, commissioned and edited by Jonathan Strahan.

Film

Fahrenheit 451 (1966)

François Truffaut

In this sly treatment, Ray Bradbury's book-burning dystopia becomes a superficially pleasant place, full of soporific comforts.

Same Us.
One Name.
One Place.

As we celebrate over 30 years in recruitment, we have taken the opportunity to bring our brands CK Clinical, CK Science and CK Technical together, to form CK Group.

We're still offering the same specialist service we have done for 30 years. We can give you access to the very latest science jobs with the world's most innovative and successful organisations...

Find the job you've always dreamed of.

Search: ckgroup.co.uk **Call:** 01246 457700

CK Group

Last shot

We have had years of missed opportunities to hit our climate goals, and with a fossil fuel gold rush triggered by Russia's invasion of Ukraine, the situation looks bleak. But ahead of COP27, there are still positives to reach for, finds **Michael Le Page**

BENEATH grey skies in China's Sichuan province, a fighter jet-like drone prepares to take off. Its mission: to release silver iodide into the atmosphere in a scientifically dubious attempt to trigger rainfall and help combat a drought associated with the worst heatwave the world has seen since records began. A few thousand kilometres to the west, meanwhile, authorities in Pakistan declare a "climate-induced humanitarian disaster of epic proportions" – caused not by a lack of rain, but by far too much of it, resulting in deadly floods.

The events of just one day – 25 August 2022, to be exact – are stark evidence of our new climate reality. Never have the dangers of global heating been so terrifyingly obvious.

Yet in terms of global action, we are in many ways going backwards. It is a year since representatives from nearly 200 countries met at the COP26 climate summit in Glasgow, UK. Key commitments made there haven't been kept, partly because of the energy crisis triggered by the Russian invasion of Ukraine. There is little reason to hope that next month's COP27 summit, in Sharm El Sheikh, Egypt, will change much either.

But dig a little deeper and there are some encouraging signs. Renewable sources of power are more economically competitive than ever. Sales of electric vehicles are taking off. Even the current energy crisis, which has sparked a dash for fossil fuels this year, may ultimately help speed up the clean energy transition. Although it is easy to be pessimistic about climate change policy, is there room for a little optimism about the future?

To understand where climate change policy is at ahead of COP27, it helps to go back to the Paris climate agreement of 2015. This set a goal of limiting global warming to no more than 2°C above pre-industrial temperatures – and preferably 1.5°C.

What countries didn't do is commit to taking the emissions-cutting actions needed to achieve this. They didn't have to, because under the agreement, it is up to each country to say what it will do to tackle climate change by 2030. These voluntary plans are known as nationally determined contributions, or NDCs.

The yawning chasm between aspiration and promises, let alone action, was meant to be closed by a ratchet mechanism. Countries are supposed to regularly increase their ambitions and submit strengthened NDCs. The first turn of the ratchet was due to happen before the COP26 meeting, which was delayed by a year because of the covid-19 pandemic.

To a limited extent, this did happen. Some high-income countries and political organisations, including the European Union, Japan, the UK and the US, did submit strengthened NDCs ahead of the Glasgow meeting, though many others didn't.

Warming win

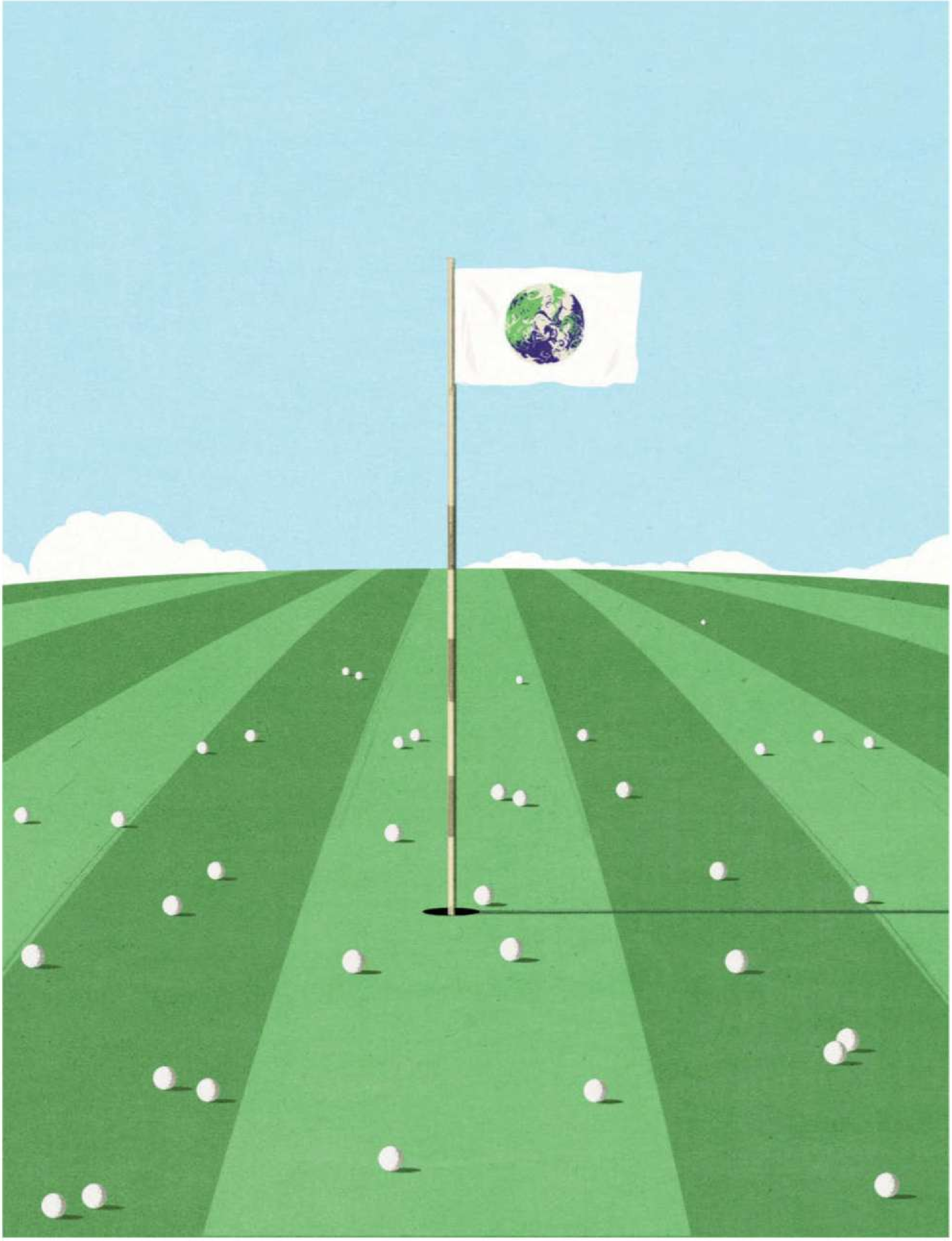
According to the Climate Action Tracker – an independent group that estimates the impact of climate policies and plans – prior to the Paris agreement, the world was heading for 3.6°C of warming by 2100, though with "a considerable margin of error due to the uncertainties of the climate system". The policies in place today would lead to warming of roughly 2.7°C – give or take a degree or so – by 2100. If countries fully implement their NDCs, it would be around 2.4°C by 2100.

So, on the one hand, there has been some progress since Paris, with more than a degree of warming probably averted. On the other, during COP26, the Climate Action Tracker described the policies and plans in place as "inadequate" when it comes to limiting warming to 1.5°C. Indeed, the average global temperature could temporarily exceed 1.5°C in the next five years and may permanently pass this level sometime in the 2030s.

This is going to lead to extreme weather and ever higher losses of lives and property. Adapting infrastructure to cope better will help reduce this, but adaptation is costly too – leading to questions about who should pay (see "It's all about the money", page 42).

This is why limiting warming is so important. In an effort to keep the 1.5°C target alive, the Glasgow Climate Pact agreed at COP26 called on countries to submit strengthened NDCs ahead of COP27. The deadline was 23 September, but just 23 countries had submitted updated NDCs by then and only one major economy, Australia, significantly strengthened its targets. Australia has long been a climate laggard, however. Its strengthened NDC merely brings it more in line with other high-income countries. It has gone from being "highly insufficient" to "insufficient", according to the Climate Action Tracker's ratings.

In fact, not one country has an NDC that is compatible with the 1.5°C target, according



ANDREA UCINI

New Scientist audio
You can now listen to many articles – look for the headphones icon in our app **newscientist.com/app**

to the Climate Action Tracker. Arguably, the only major economy with targets that come close is the UK, where the plan is to reduce emissions by 68 per cent compared with 1990 levels by 2030. But progress towards meeting these targets isn't on course.

"The UK is massively off track," says Tom Evans at independent climate change think tank E3G in the UK. What's more, recent UK government policy announcements, such as reversing a ban on fracking in England and efforts to extract more North Sea oil and gas, mean the country is going even further awry.

The bottom line is that with time running out fast, the world isn't even close to doing enough to limit warming to 1.5°C.

"Unfortunately, there is a growing sense that the Paris temperature goal is slipping away," Egyptian foreign minister Sameh Shoukry, who will preside over COP27, acknowledged in a video statement on 19 September.

Shoukry went on to call for countries to act more swiftly and decisively, but the Egyptian government isn't in the best position to persuade other countries to increase their targets at COP27. This year, Egypt did submit an updated NDC – which, as with the NDCs of many low-income countries, is conditional on international support – but it didn't contain a stronger target. The Climate Action Tracker estimates that Egypt's emissions would increase by around 50 per cent above today's levels by 2030 under this NDC and rated it "highly insufficient".

"Renewables are now by far the cheapest energy source almost everywhere"

Recent floods in Pakistan have left a trail of destruction

FIDA HUSSAIN/AFP VIA GETTY IMAGES

A major reason why some countries are backsliding on climate goals is the energy crisis triggered by Russia's invasion of Ukraine. Russian president Vladimir Putin seems to have thought he could dissuade European governments from supporting Ukraine by withholding supplies of Russian natural gas, which many countries in the region rely on. That has proved largely wrong, but it has left these countries scrambling for other sources, helping drive fossil fuel price surges that are having knock-on effects around the world.

Niklas Höhne at the NewClimate Institute in Germany, one of the organisations behind the Climate Action Tracker, says countries facing a gas shortage had three options: reduce their energy usage, accelerate renewable projects or find alternative sources of fossil fuels. All were necessary, but the emphasis has been almost entirely on fossil fuels, he says. "There's a lot of things going in the wrong direction," says Höhne. "There's a gold rush for new fossil fuels."

European countries have been buying coal from all over the world to use for electricity generation instead of gas, and coal generation produces higher emissions. Some coal plants that were due to shut down will now continue operating, while a few that had just closed are resuming operations.

Countries in Europe have also found an alternative to Russia's gas in the form of liquefied natural gas, or LNG, which is being imported in ships, rather than pipes, from countries like the US and Qatar. But this switch isn't looking like a temporary measure soon to be replaced by low-carbon sources. Instead, new infrastructure for compressing and exporting LNG, and for importing and turning it back into a gas, is being planned and built around the world. Germany is reportedly negotiating contracts lasting decades. "If all this infrastructure is built and used, we will miss the 1.5°C target," says Höhne. "That's very clear."

In addition to finding alternatives to Russian gas, many countries have also introduced schemes to help people and businesses cope with the shock rises in energy costs. But here, too, most governments are supporting the status quo rather than accelerating the transition to a greener economy. For instance, help with energy bills should be targeted at those on low incomes, says Höhne. He adds that shielding wealthier people from price rises diminishes their incentive to reduce energy use – by turning down the heating, for instance – or to invest in energy-saving measures, such as installing insulation.

The response to the energy crisis is thus a lost opportunity. "We are not seeing governments universally realising that a stronger double-down on renewable energy, on energy efficiency, would actually be the best path out of this," says Evans.

However, the energy crisis isn't universally bad news for the climate. Producing LNG, transporting it and then turning it back into a gas may take a lot of energy, but, surprisingly, Europe's switch to LNG may result in lower emissions in the short term than sticking with Russian gas, according to some estimates. This is because the long Russian pipelines to Europe are thought to leak so much methane that this outweighs all the additional energy associated with LNG.

The longer-term impact of the energy crisis might have environmental benefits, too. Russia has no way of selling as much gas to countries outside of Europe. Its capacity to export gas as LNG via ships is limited because it lacks the infrastructure and a second planned pipeline to China isn't due to be finished until 2030 and will have less capacity than the ones to Europe, says intelligence analyst Oliver Alexander. What's more, Russia's pipeline and LNG infrastructure are dependent on components made in the West that companies are no longer allowed to sell to Russia.

Unsustainable fuel

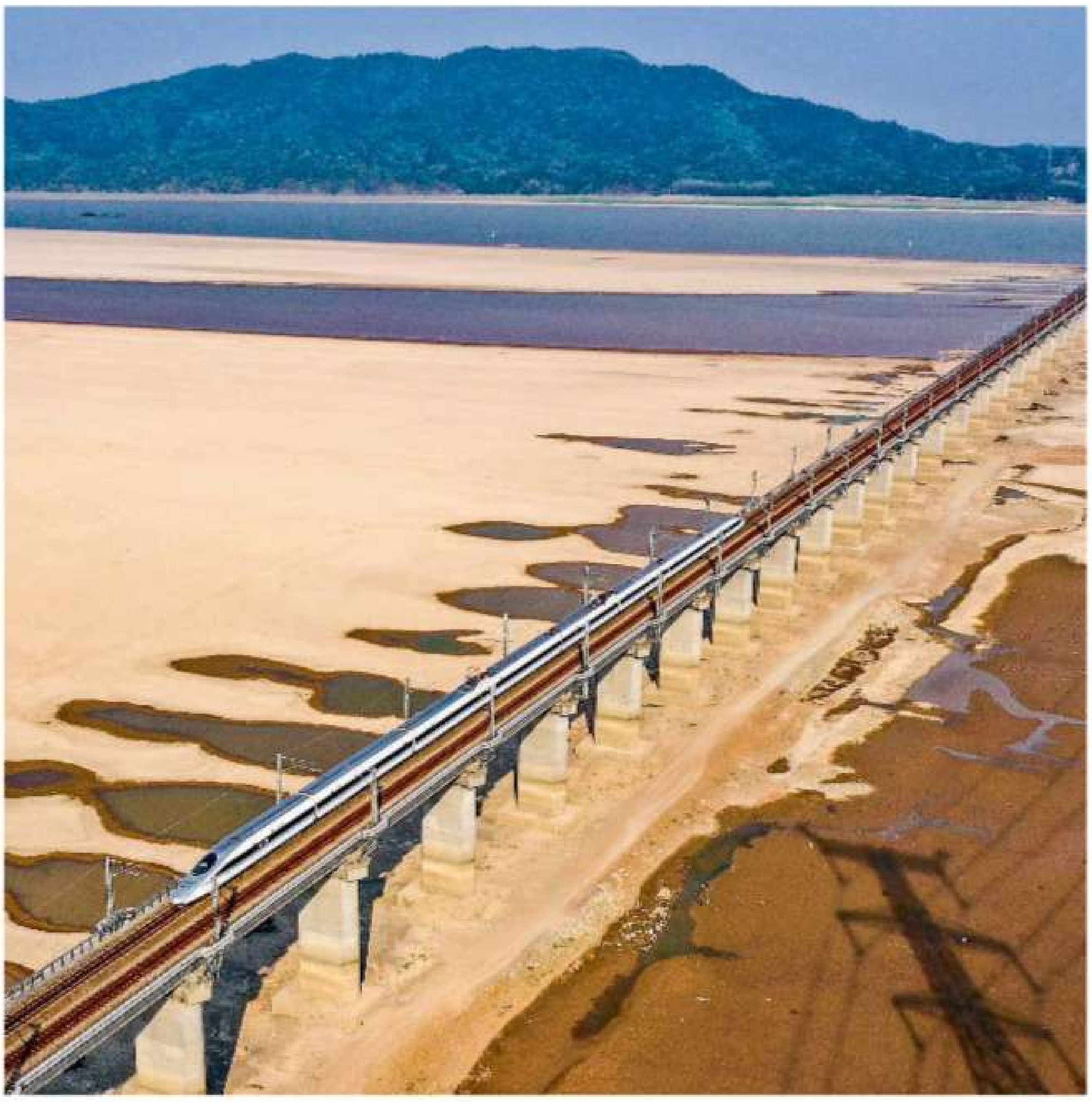
"I don't see China getting too much of their gas from Russia. They won't put themselves in a similar situation to Germany," says Alexander. "China will, at some point, also try to pivot away from natural gas."

If economic sanctions imposed on Russia in response to the invasion of Ukraine stay in place, the country's gas exports may remain lower than they would otherwise have been for years. Its domestic emissions, meanwhile, may fall because the country's economy will be smaller as a result of the sanctions.

There may be other ways in which the energy crisis will ultimately lead to a fall in fossil fuel use and a boost for climate action. It is, after all, a stark reminder of the dangers of relying on unsustainable fossil fuels, as Fatih Birol, head of the International Energy Agency, wrote in the *Financial Times* in September: "After winter comes spring. The oil shocks of the 1970s resulted in major progress in energy efficiency, nuclear power, solar and wind. Today's crisis can have a similar impact and help speed up the shift to a cleaner and more secure energy future."

The EU, for instance, is currently negotiating a set of policies designed to achieve its target of reducing emissions by 55 per cent below 1990 levels by 2030.

›


CFOTO/FUTURE PUBLISHING VIA GETTY IMAGES

Lakes in China have dried up this year due to a severe drought

FELIX CESARE/GETTY IMAGES

Liquefied natural gas can be transported in large ships

SEAN GALLUP/GETTY IMAGES

The economics of wind power are very competitive

It has made some of these policies more ambitious in response to the crisis and could now exceed that target. This should enable the EU to strengthen its NDC, though that won't happen before COP27.

Beyond the energy crisis, there have been promising developments in the US this year. In August, the country passed the Inflation Reduction Act, which has been called the biggest thing Congress has ever done to address climate change. Among other things, it requires $370 billion to be invested in a wide range of clean technologies. While the act is focused on the US, it will also have a global impact both politically and by helping lower prices for clean technology.

Then there is the adoption of electric vehicles, which is proceeding much faster than seemed possible a decade or so ago. Many countries now plan to stop the sale of new cars with internal combustion engines, with Norway set to do so in 2025.

Temporary blip

Perhaps the greatest reason for optimism is that, over the past decade or so, renewables have gone from being prohibitively expensive to the cheapest option in many cases.

"We've seen a dramatic reduction in the cost of clean technology, and those costs are continuing to come down," says Evans. "Renewables are now by far the cheapest energy source almost everywhere."

Wind and solar now account for 75 per cent of global electricity capacity growth, up from 20 per cent in 2008. That is still not nearly enough – we need low-carbon energy sources to be displacing fossil fuels, leading to declining fossil fuel use even as global energy consumption rises. But that turning point is getting closer. "The economics of renewables is incredibly competitive and will continue to be so," says Evans.

This means the current rush to exploit more fossil fuels and build more fossil fuel infrastructure is likely to be a temporary blip. In fact, Höhne thinks much of the fossil fuel infrastructure currently on the drawing board will never be built or used – especially coal-fired power stations. "You cannot run them economically," he says.

The hope of many is that we are nearing an economic, social and political tipping point where the pace of decarbonisation will accelerate dramatically. We aren't there yet, says Damon Matthews at Concordia University in Montreal, Canada, but as costs fall and the terrifying consequences of global heating become ever more obvious, politicians may be emboldened to take ever more ambitious action.

"The way political and social change works is a whole bunch of incremental changes and then a step change," he says. "At some point, we are going to reach that." ▮

Michael Le Page is a reporter at *New Scientist*. Follow him on Twitter @mjflepage

It's all about the money

To reduce carbon dioxide emissions and adapt to a hotter world with ever-more extreme weather, each country must invest huge amounts of money. But lower-income nations don't have much to spend.

At the COP15 climate meeting in 2009, high-income countries promised to provide $100 billion a year in climate funding, mostly in the form of loans. This target has yet to be achieved. For instance, according to Oxfam, the reported amount of funding for 2017/18 was $60 billion, but the true amount was $20 billion.

Part of this climate funding is meant to go towards adaptation, such as improving flood defences. Last year at COP26, high-income nations promised to double adaptation funds to $40 billion a year. Once again, much of this money has failed to be provided, with pledges so far amounting to around $22 billion annually by 2025.

In the lead-up to COP27, many lower-income countries and activists are again pushing hard for an agreement on "loss and damage" – the idea that the high-income nations responsible for most of the global warming so far should compensate the less wealthy countries that are being hit hardest by warming-fuelled extreme weather. These events are pushing many countries further into debt. For instance, the recent floods in Pakistan are estimated to have caused at least $10 billion in damage.

"We are not able to see a future because flooding, cyclones and typhoons are washing away all economic development that our countries have been struggling to get," said Ineza Umuhoza Grace at the Loss and Damage Youth Coalition at a recent webinar hosted by Carbon Brief, a UK-based website covering climate science and policy. "When disaster happens, there's no international process that listens to the cry of a country."

High-income nations have long resisted any kind of compensation becoming part of global climate agreements, and there is unlikely to be any substantive progress on this at COP27, US climate envoy John Kerry told a conference in New York in September. "You tell me the government in the world that has trillions of dollars, because that is what it costs," he said.

NABIL NEZZAR

Sweet nothings

The role of artificial sweeteners in health is controversial, but the more we discover about their potential effects, the greater the imperative for answers, as **Allison Sylvetsky** tells Helen Thomson

YOU could be forgiven for being completely confused when it comes to consuming low-calorie or artificial sweeteners. Some days, the headlines are full of praise for their beneficial effects on health, helping people to lose weight by replacing their favourite sugary drinks and treats with similar-tasting diet versions. At other times, we are told low-calorie sweeteners are linked with serious health conditions, from raising blood pressure to an increased risk of type 2 diabetes. Just last month, a large study of French adults claimed to have found an association between consuming sweeteners and an increased risk of heart disease.

Allison Sylvetsky, an associate professor in the department of exercise and nutrition sciences at George Washington University, Washington DC, is trying to unpick the science involved in this controversial topic. Her work is shedding light on whether artificial sweeteners can give us the sweet fix we seek while helping us to maintain our weight and prevent chronic disease, or whether they should be handled with care.

Helen Thomson: It is widely accepted that too much sugar is bad for you. Artificial sweeteners are a supposedly healthy replacement, so can you tell us some of their proposed benefits?
Allison Sylvetsky: Sure. We know that too much added sugar is not good for our health. Artificial sweeteners provide a sweet and

›

palatable alternative that has few or no calories. Until recently, it's been the belief that these sweeteners don't really do anything in the body because they don't contain sugar or calories. So the benefit of replacing sugar with artificial sweeteners in foods and beverages is that this replacement lowers the product's calorie and sugar content.

But now it seems that things aren't so straightforward?
Lately, there's been more and more evidence from both rodent and human studies showing that artificial sweeteners may contribute to metabolic abnormalities and various health problems. However, there are trials that show that, when used judiciously, sweeteners may be helpful for weight management. That's where the controversy is. [Part of the] challenge is that these trials may not reflect the way that sweeteners are actually used in real life and the studies showing associations between sweetener use and health problems cannot show causality.

What changes when we look at how people use sweeteners in real life?
Most artificial sweetener trials have relied on comparing diet beverages with those with added sugar. Until a couple of decades ago, diet beverages almost entirely contained either aspartame or saccharin. Now, there are newer artificial sweeteners on the market and they've been incorporated into more and more foods and beverages. There's not a lot of research that is specific to particular sweeteners, and studying them is challenging because they're used in diet drinks, but also in yogurts and snack foods and even in ice creams. They're also used in beverages that aren't even considered diet drinks, and which also have added sugar. So, frankly, it's unlikely that people are using sweeteners as one-to-one replacements for added sugars. And they might be saying: "I had a diet soda, so I can have another cookie."

So are the potential negative effects of sweeteners down to how people are using them, or could sweeteners themselves be causing problems?
I would say potentially both. More and more, we're seeing that these sweeteners are not inert – they don't have calories and they are not sugar, but they do exert metabolic effects in the body. The big question is, how relevant are those mechanisms to human health? There's a discrepancy in the data. Most of the randomised controlled trials of artificial sweeteners have focused on weight loss, but not on some of the other health outcomes. And the randomised controlled trials are relatively short term and the people in them might be already motivated to lose weight. Observational studies link consumption of various sweeteners to unfavourable health effects, including, for example, increased risk of diabetes, cardiovascular disease and stroke. They're not randomised or controlled, but they may better capture real-life exposure to sweeteners in the context of how people actually eat.

Is there one type of sweetener that is worse for you than others? There seem to be different rules for which sweeteners are approved and which aren't, depending on the country you are in.
Most studies group different artificial sweeteners together when studying their effects. But given they are different compounds, they may have different effects. Sweeteners all have different chemical structures, different physical properties. They are all absorbed differently. Some are metabolised, some aren't. They're excreted differently. And they're not always consumed alone. Take sucralose, for instance. Taken in water, there is no effect on blood glucose levels. But there's evidence to show that when it is consumed in combination with sugar, it alters the body's glucose and insulin levels [differently than sugar alone]. If the mechanism that contributes to poor health outcomes is sweetness, then we would expect all artificial sweeteners to have similar effects, but if the mechanism is compound-specific, then sucralose might be different than aspartame and so on. And it might be a combination of the two – some effects being due to sweetness and some being compound-specific.

"Trials may not reflect how sweeteners are used in real life"

If you have a diet soda, do you go on to eat more sweet food?

CATHERINE FALLS COMMERCIAL/GETTY IMAGES

We have spoken a lot about artificial sweeteners. Do natural sweeteners like stevia have similar controversies around their use?
Unfortunately, there is not a lot of research on the metabolic and health effects of stevia in humans, and it is a really important question because the use of stevia in foods and beverages has increased markedly in recent years. The few studies that have been conducted report that stevia helps reduce inflammation, improves control of blood glucose and encourages weight management. Stevia may be a favourable alternative to other low-calorie sweeteners, but this is not yet clear and more studies in humans are needed.

Last month, a study of French adults claimed to show a direct association between higher artificial sweetener use and cardiovascular risk. What do you think it added to the debate?
It was a very well-done study. They enrolled a large cohort and it was unique in that they collected repeated and detailed estimates of food consumption and looked at different sweeteners separately. They also considered sweeteners from foods, beverages, packaged sweeteners, all different dietary sources. The results further justify the need to conduct experimental studies to better understand the metabolic effects of sweeteners in humans.

It is hard for a consumer to make sense of all this. Studies like the French one suggest there may be a link between sweetener use and poor health, but the website of England's National Health

SHUTTERSTOCK/ANNA-MARI WEST

You may be surprised by some of the foods that contain artificial sweeteners

Service says they are "perfectly safe to eat or drink on a daily basis as part of a healthy diet". Should we be using them or not?
I think it depends on what we mean by safe, because these sweeteners have been extensively tested and approved by various regulatory bodies worldwide with regard to toxicity. But where the debate is focused is on metabolic effects and their role in weight management and chronic disease risk. In this case, the question is, are they helpful or harmful in terms of weight management and chronic disease? We don't have a clear answer to that question yet, but more and more evidence suggests that these low-calorie sweeteners may not be helpful and may actually be counterproductive.

Your own research examines the consumption and effects of low-calorie sweeteners in children. What have you discovered?
We've done several different studies on consumption of sweeteners among children. Studies have shown that the prevalence of consumption of low-calorie sweeteners has been increasing, and particularly in children. That's not surprising, as there is more emphasis on reducing added sugar to food; there's an increased presence of sweeteners, including those that are marketed to and widely consumed by children. This trend is being seen globally, not just in the US, and really highlights the importance of having a better understanding of how these sweeteners are impacting kids in terms of their weight and metabolic health. We have a couple of ongoing studies – one is in kids with type 1 diabetes, where we're investigating how restricting their use of sweeteners affects their glucose levels and metabolic risk factors.

You're still collecting data on this, but what do you expect to see?
In rodents, and now in humans too, studies show that repeated consumption of low-calorie sweeteners – specifically saccharin and, more recently, sucralose – led to impairments in the ability to keep blood glucose within an ideal range. So we hypothesise that removing sweeteners from the diets of children with type 1 diabetes might lead to improvements in the amount of time they are within the target blood glucose range relative to those who continue consuming sweeteners.

Have you got any ideas about possible mechanisms that might be involved?
One of the mechanisms being studied a lot right now is how sweeteners change the composition of the microbiota in our gut – the bacteria in our intestinal tract. Rodent data and a relatively large study from Israel in humans published recently showed that impairments of glucose tolerance are mediated by changes in the gut microbiome. They showed that repeated consumption of saccharin and sucralose causes changes in the gut microbiome composition that adversely impact glucose intolerance.

Given the mounting evidence, I am surprised there isn't more nuanced advice on the consumption of sweeteners.
It's still a highly controversial topic and it's a polarised field of research. Yes, there's growing evidence suggesting there may be negative effects of prolonged low-calorie sweetener consumption on metabolism. But it's not yet a conclusive body of evidence. It's important to acknowledge the limitations and critiques of scientific studies – that's how research works. And we want to make sure the science isn't being sensationalised.

The study from Israel also showed how personalised the effects of low-calorie sweeteners are on the gut microbiome. It's something that varies between individuals and is challenging to disentangle. There are likely some people who respond negatively to sweeteners and some that do not. The reality is that understanding how these things affect our health takes a lot of time. And we really need conclusive evidence to inform policy. ▮

Helen Thomson is head of features at *New Scientist*

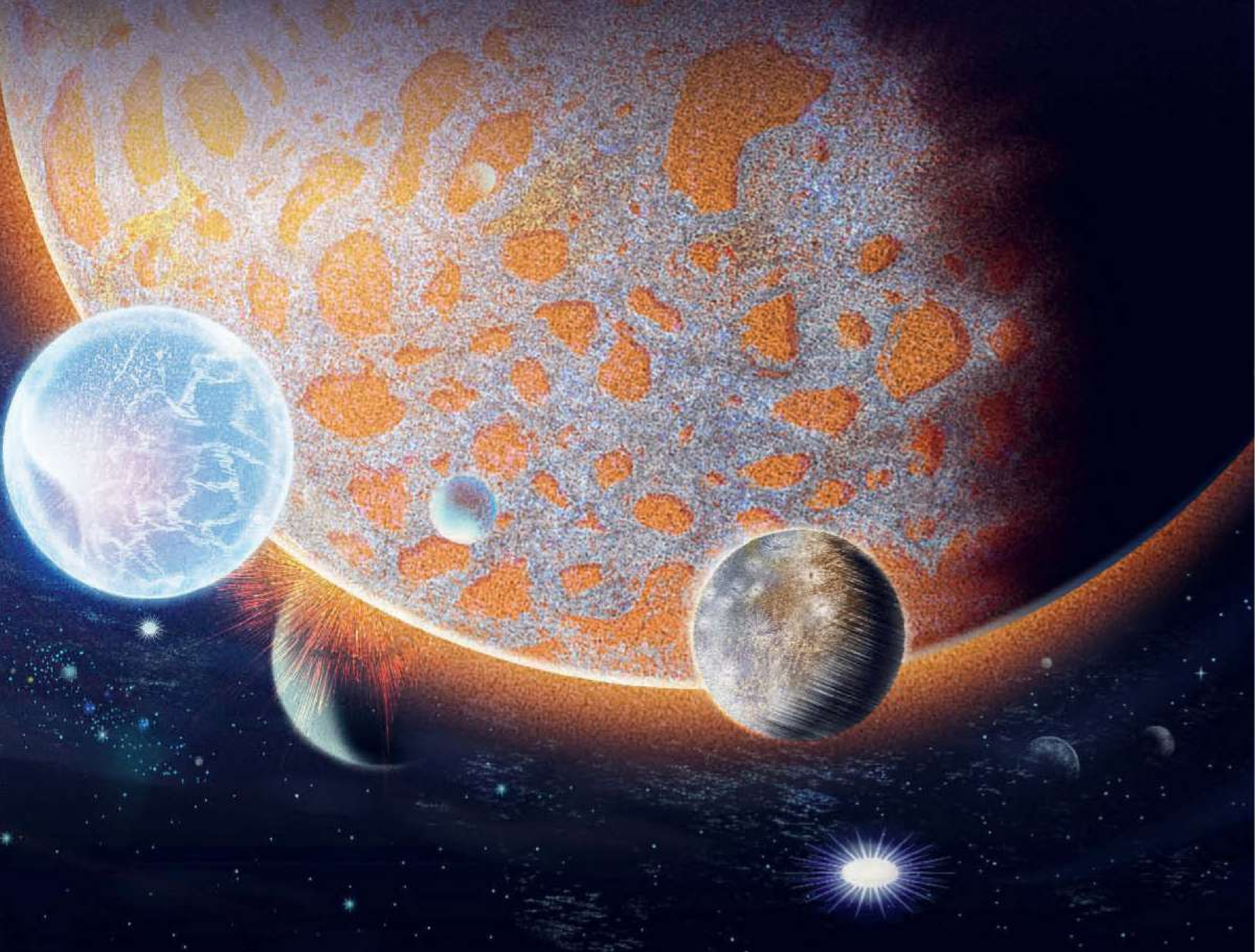
LUONGDOO

Water, water everywhere

Ocean worlds, planets flush with water and potential homes to alien life, look like they could be common in the galaxy. The race is on to find one, finds **Conor Feehly**

IT LOOKS like there is nothing below the thick, hot clouds we are falling through. But descend a little further and the vista opens up to show an ocean as far as the eye can see. Its surface is steaming, feeding water vapour into the sky. Plunging into the waves, it is hot at first, but cools as we travel further into the darkness, the pressure becoming immense. We dive down hundreds of thousands of metres until we reach the bottom where, instead of rock, the sea floor is made of ice. We have landed on a water world.

When astronomers began discovering planets outside our solar system in the 1990s, they realised that alien worlds come in an array of orbits, masses, sizes and compositions. These exoplanets couldn't be placed in simple rocky or gassy groups like those in our solar system. Some, it has even been suggested, could be 50 per cent rock and a whopping 50 per cent water. Send a spacecraft to a planet like this and the scene it would encounter may be similar to our imagined journey: a thick water vapour atmosphere shielding a vast ocean hundreds of kilometres deep, with an icy mantle below.



It was long thought these water planets would be rare, if they existed at all. But fresh insights have led many astronomers to think they may, in fact, be relatively common – and could be promising places to search for alien life. The race is now on to find one.

Life – as we know it, at least – is inextricably tied to liquid water. Our best guesses about the conditions from which life emerged on Earth involve either nutrient-rich pools of water on our planet's rocky surface or deep-sea hydrothermal vents. Either way, it had to be wet. To this day, all life on Earth uses water at some point in its life cycle. So close is the relationship between water and life that our search for extraterrestrial organisms has been largely determined by the presence of that one simple molecule: H_2O.

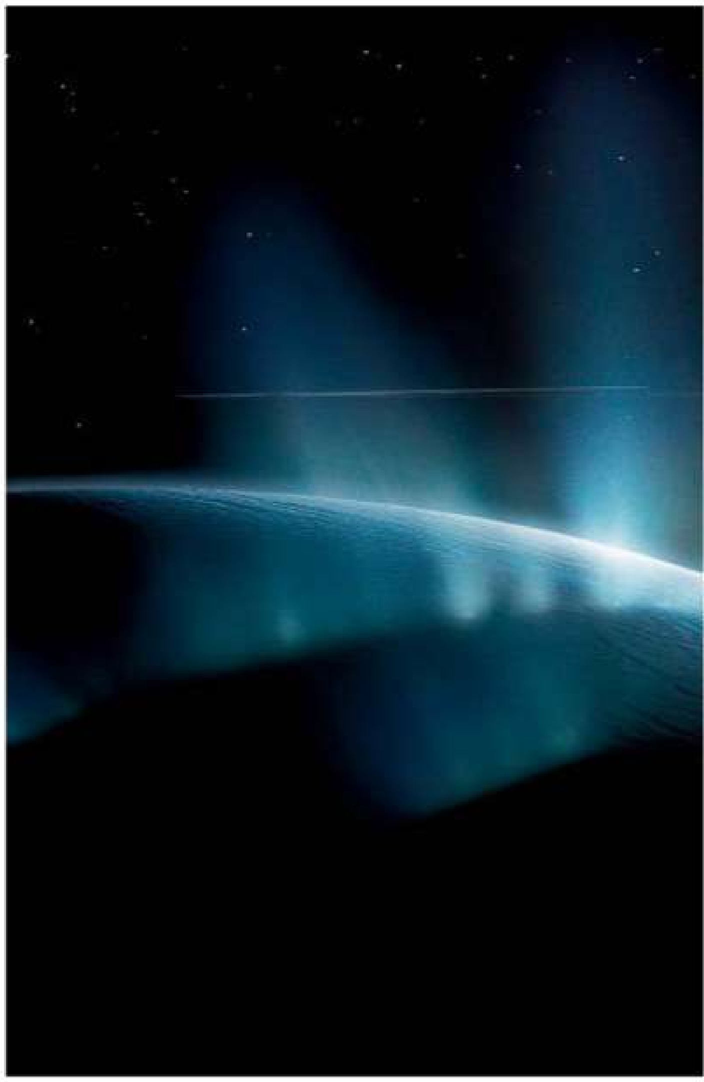
The idea of exoplanets that not only contain water, but are covered in the stuff, first burst onto the scene in 2004, when Alain Léger, then at the Paris-Sud University in France, and a group of international researchers introduced a new family of planets. These hypothetical worlds initially resembled the ice giants of our own solar system, Uranus and Neptune, which possess vast reservoirs of ice. But instead of remaining in the outer regions of their solar systems like our ice giants, the theoretical ocean worlds migrated during the early phases of planetary formation, when everything was a little chaotic. This movement took them closer to their suns, into the habitable zone, the region around a star in which liquid water can exist on a planet's surface. In this scenario, Léger and his colleagues argued, a planet's reservoirs of ice could melt, leaving a surface ocean of liquid water potentially more than 100 kilometres deep. With so much water, such a world could be booming with life. But critics found one big problem with the idea: if an ice giant did migrate to an orbit closer to its home star, it was likely to lose its atmosphere and any ocean on the surface would eventually evaporate away due to the heat of the star.

Around the same time, exploration of our solar system was revealing another kind of ocean world. Through NASA's Galileo mission, which spent eight years orbiting Jupiter until 2003, planetary scientists discovered that a few of the Jovian moons, such as Europa and Ganymede, were hiding oceans beneath thick sheets of ice. Then, in 2005, NASA's Cassini spacecraft found evidence for plumes of water erupting from Enceladus, a moon of Saturn.

What distinguishes these moons from the kind of worlds suggested by Léger and his colleagues is that their water isn't at the surface, but buried deep below. For those interested in ocean-rich planets outside our solar system, this solved one problem. "You don't have to worry about the atmosphere being stripped away," says Kathleen Mandt at Johns Hopkins University in Maryland. "The ice protects the water from being lost."

But while an icy surface can preserve a water world's oceans, and hence its habitability, a different type of ice may threaten it. This is to do with size. If an Earth-sized planet were to have a similar buried ocean to those we have seen on smaller moons, the immense gravity and pressures at the depths possible on water worlds would compress some of the water into exotic forms of ice that don't occur naturally on Earth. For years it was thought this kind of ice may prevent some life-friendly elements that are found in a planet's core, such as carbon, iron, phosphorus and silicon, ›

Join us at the world's greatest festival of science!
Get your super early bird tickets for New Scientist Live 2023
newscientistlive.com


MARK GARLICK/SCIENCE PHOTO LIBRARY/ALAMY

> "Life on Earth is unique to Earth. On another world, it might be different"

from mixing with a liquid ocean above.

In recent years, research has suggested these high-pressure ices don't automatically rule out the possibility of life. In fact, they might help it. Assuming heavy elements and organic molecules from the rocky core can reach the liquid regions of water worlds, then it is also important that those ingredients are mixed across different depths in the wider ocean. On Earth, similar upwelling and mixing in the oceans opens up different niches for organisms to occupy, and provides the raw materials for life over vast oceanic distances.

In 2018, simulations suggested high-pressure ices may churn through a process called solid state convection similar to the movement of rock in Earth's mantle, says Sam Howell at NASA's Jet Propulsion Laboratory in California. On top of this, the radioactive decay of heavier elements, such as potassium, thorium and uranium, in the cores of these planets may provide enough heat to drive this movement. "It's possible melt may be generated at the ice-rock boundary," says Howell, "providing a crucial site for the mixing of water and heavy elements."

Consensus was building that water worlds with buried oceans, or those on the surface, if they were to persist, could be a great place for life to thrive. But astronomers were still uncertain about how common they might actually be in the cosmos. This comes down to the way we study exoplanets. By carefully watching the way planets block some light from their host stars as they pass between them and us, we can infer these planets' masses, radiuses or sometimes both. If we know both, we can deduce their density. But a rocky planet with a thick hydrogen atmosphere could have the exact same density as an ocean world, says Owen Lehmer at NASA's Ames Research Center. "How do you know which one is going to be correct when they both might have water in the atmosphere?" he says. "It's a really interesting challenge."

Li Zeng at Harvard University offered a solution to this in 2018. Along with a team of astronomers, Zeng zoned in on a subset of the 4000 or so exoplanets that had been discovered at the time: those between two and four times the size of Earth. When Zeng and his team analysed the radiuses and densities of these exoplanets, two distinct groups emerged: one for small, dense rocky planets, and another for larger, intermediate-sized worlds.

The prevailing idea was that these intermediate planets – 1400 or so of them – were mini-Neptunes, planets with rocky cores surrounded by thick envelopes of hydrogen gas, uninhabitable as far as life on Earth is concerned. But these mini-Neptunes didn't quite fit into a neat category. "They are not dense enough to be rock and iron, but they don't seem to be quite puffy enough to be hydrogen-rich planets," says Lehmer.

Zeng and his team suggested that, rather than being mini-Neptunes, these planets are water worlds. Planets composed of 50 per cent ice and 50 per cent rock are more likely to represent this second peak in the exoplanet data, they argue. They reasoned that the higher gravity associated with larger gas giants meant they would steal most of the hydrogen gas present in the protoplanetary disc (the materials which coalesce to form a planetary system), leaving the smaller planets with high volumes of commonplace ice.

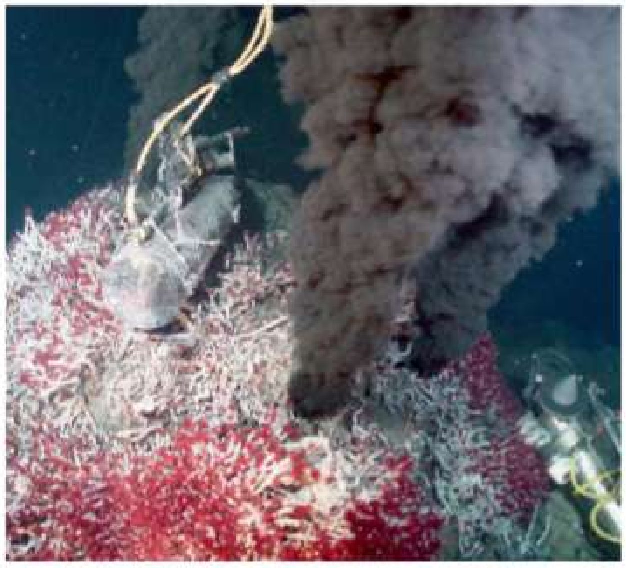
What's more, when modelling the atmospheres of these proposed water worlds, the team found that, if the planets had the right chemical balance, then methane, ammonia and hydrogen coming from the vast water reservoir could replenish the gradual loss of atmosphere. If the atmosphere remained intact, evaporation from the ocean would be stalled, preserving a possible oasis for life below. On this particular result, Lehmer remains cautious. "Any research on the prevalence of water worlds is still going to be highly uncertain," he says.

Still, the consensus about water worlds was shifting. Together with Zeng's modelling, findings from ancient meteorites that show ice was a common ingredient in the early solar system and the detection of water in the atmospheres of several exoplanets have persuaded some astronomers that water was a regular ingredient in the formation of planets. Water, after all, is composed of two of the most abundant elements in the universe, hydrogen and oxygen, and was one of the most common molecules when our own solar system formed.

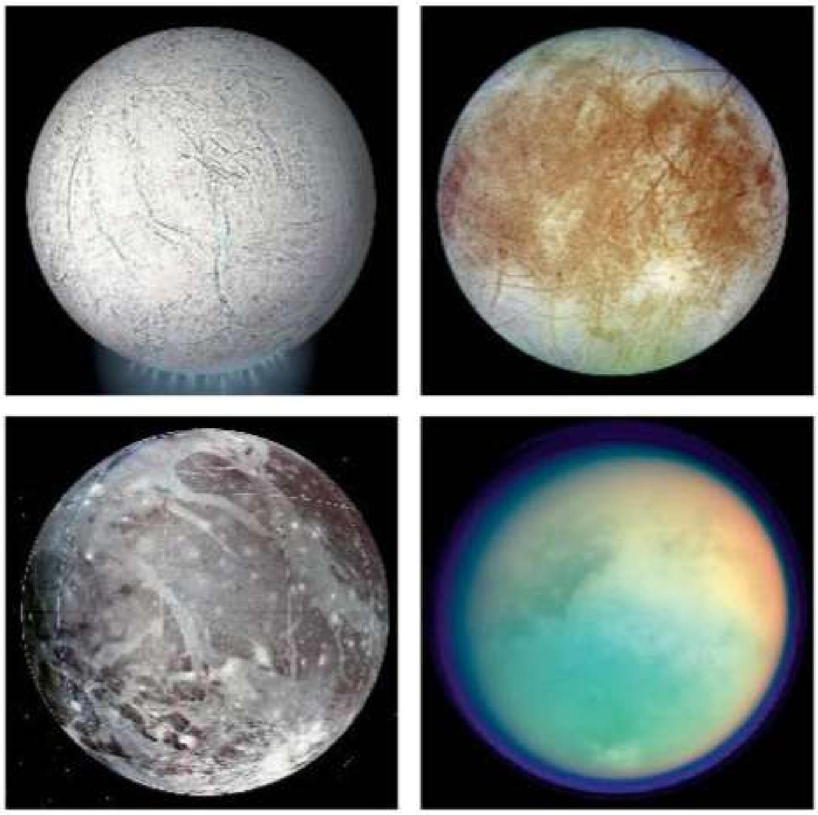
Today, it is generally agreed that there are two kinds of watery exoplanets. The first is a planet that starts further away from its star and contains lots of ice. As it moves closer to its star, the ice melts to form an ocean on the surface, which delays the loss of atmosphere, says Mandt. Or, like Enceladus, there is an icy layer keeping the water in.

The prevalence of water worlds is going to remain a mystery until we can find them outside our solar system. Luckily, the James Webb Space Telescope (JWST) is going to spend a lot of time analysing the atmospheric compositions of potential habitable worlds. And there is a system with a possible water world right on our galactic doorstep.

TRAPPIST-1, with seven known rocky worlds,


NOAA

Life might have emerged close to hydrothermal vents, like this one in the Pacific Ocean



We know some moons in our solar system are rich in water: Enceladus (left and top left of the four smaller images) has water shooting out of it. Europa (top right) and Ganymede (bottom left) have buried oceans, as does icy Titan (bottom right)

NASA/JPL

is just 40 light years from Earth. In 2021, Eric Agol at the University of Washington in Seattle and his team estimated that at least four planets in the system could have significant water. The most promising is TRAPPIST-1h, which could be as much as 10 per cent water.

Plans to peer at TRAPPIST-1h in the ultraviolet using JWST might just reveal a Titan-like atmosphere that could be indicative of a vast ocean beneath its surface, says Mandt. "If we find a lot of methane, but not much oxygen or carbon monoxide, that would be an indication of cryovolcanic activity and a Titan-like atmosphere," she says. "In other words, ice volcanoes."

A team led by Mandt has now suggested using Saturn's moon Titan, with its subsurface ocean, as a model for making observations of TRAPPIST-1 h's atmosphere. The two bodies might have a lot in common. Both exist outside of the habitable zone, both probably have liquid oceans beneath a frozen surface and both might have extensive atmospheres. With exoplanets like TRAPPIST-1h, we are limited in the types of observations we can make, whereas with our solar system's icy moons, we are able to look at the surface and make inferences about their compositions directly. This is why using the moons is useful to help us understand exoplanets.

If TRAPPIST-1h doesn't have an atmosphere, it doesn't rule out the possibility of an ocean. It might resemble something more like Europa, which has an ocean beneath a thick sheet of ice. Due to its lack of cryovolcanic activity, Europa doesn't really have an atmosphere, except for the occasional plume of material that comes up from the ice, which is quickly lost to space. Learning anything about the moon's composition by observing its atmosphere is virtually impossible.

Could life survive on such a world? Promising clues come from another moon. In September 2022, jets spewing from Enceladus were found to contain all of the ingredients necessary for life on Earth: carbon, hydrogen, nitrogen, oxygen, phosphorus and sulphur.

Hints from Earth also suggest it is possible. In 2021, James Smith and Paul Anker at the British Antarctic Survey discovered an ecosystem of sponges and barnacles 900 metres below the Antarctic ice shelf – 260 kilometres away from the nearest source of water where photosynthetic organisms can survive. The community may use a form of chemosynthesis, with methane and hydrogen sulphide being potential sources of energy. This is one way life could survive in a sunlight-deprived, icy water world.

Earth can only tell us so much, however. "Life on Earth co-evolved with our planet," says Adrienne Kish, a microbiologist at the National Museum of Natural History in Paris, France. "This means that life on Earth is unique to Earth and life on another world, if it exists, will have undergone a different path with likely a different end product." Some of the basic building blocks, like amino acids, might be similar, as we have spotted these things in interstellar clouds. But on water worlds, any life would have to be equipped to survive high pressures, high salt content and extreme temperatures, as the oceans are likely to be cold away from any hydrothermal vents.

If TRAPPIST-1h doesn't turn up the goods, there is no shortage of other exoplanets to explore. In 2019, observations made with the Hubble Space Telescope confirmed water in the atmosphere of K2-18 b – a planet of around eight Earth masses in the habitable zone of a red dwarf, 124 light years away. Water was also tentatively detected in the atmosphere of planet LHS 1140 b, which is around seven Earth masses and lies within the habitable zone of its star, which is 40 light years away. Modelling estimates have suggested the planet could be around 4 per cent water, which is enough for it to have oceans hundreds of kilometres deep.

But that pales in comparison with TOI-1452 b, discovered in August, whose size and mass suggest it could be 22 per cent water. This planet is 100 light years from our solar system and orbits a pair of red dwarfs. Its 11-day orbit puts TOI-1452 b well within the habitable zone of its two parent stars, and René Doyon at the University of Montreal plans on booking time with JWST to get a more detailed look at it soon. One way or another, observing a distant water world seems like a matter of when, not if. ▮

Conor Feehly is a freelance writer based in Auckland, New Zealand

Leave a lasting impact in society. Study one of our new engineering courses. Join us on Saturday 19 November to find out more.
city.ac.uk/opendays

School of Science
& Technology

www.city.ac.uk

Micropathology Ltd

Tel 24hrs: +44 (0) 24 - 76 - 323222

POSTDOCTORAL SCIENTIST - MOLECULAR DIAGNOSTICS

We provide a clinically supported service for the rapid diagnosis, research and management of infectious disease.

We are seeking a motivated post-doctoral scientist with molecular experience to work within our Microbiology division.

Daily duties will include performing PCR, result interpretation, reporting and administrative tasks. Appointees will assume responsibilities for service improvement. Occasional part time attendance at weekends may be required.

Candidates will possess a PhD in biological/medical/biochemical sciences. Candidates must have good literacy, IT and mathematical skills. Good scientific knowledge and logical approach is essential. Previous experience in clinical microbiology would be helpful, as would familiarity with quality management systems (the laboratory is accredited to UKAS standards). Staff are encouraged to contribute to the company's extensive research portfolio.

Applicants must be legally entitled to work in the UK.

The successful applicant will be appointed for a probationary period and subject to satisfactory performance will be offered a permanent post. Pay and pension will be competitive and commensurate with skills/experience.

Applications (CV and hand-written covering letter) should be submitted to Helen Healy at the address above.
Requests for more information should be sent to **personnel@micropathology.com**

Early applications encouraged. Direct applications only. Closes end of November 2022

University of Warwick Science Park, Venture Centre, Sir William Lyons Road, Coventry CV4 7EZ, United Kingdom

Website: www.micropathology.com   Email: info@micropathology.com

The back pages

Puzzles
Try our crossword, quick quiz and logic puzzle p53

***Almost* the last word**
What would the most average person in the world be like? p54

Tom Gauld for *New Scientist*
A cartoonist's take on the world p55

Feedback
Holy nitpicking and quantum spirituality: the week in weird p56

Twisteddoodles for *New Scientist*
Picturing the lighter side of life p56

The science of cooking

Sweetening the pot

It is always best to bake your sweet potatoes, but here is a trick to take the tubers to another level of deliciousness, says **Sam Wong**

Sam Wong is assistant news editor and self-appointed chief gourmand at *New Scientist*. Follow him @samwong1

What you need

Sweet potatoes
Any topping you like

DELICIOUS meals don't get much simpler than a baked sweet potato. But a little science can tell us how to maximise this dish's sweetness and deepen its flavour.

Sweet potatoes are between 1 and 2.5 per cent sugar when raw, but they get sweeter as they cook thanks to the work of amylase enzymes that break down starch into simple sugars. These enzymes are most active at 75°C (167°F).

A study from 2012 found that the sugar content of one type of sweet potato was almost five times higher after baking for 90 minutes, mainly due to an increase in maltose. A fragrant aroma and soft texture are also important to the experience, and the cooking method has a big effect here. Another study analysed the aroma compounds produced by baking, boiling and microwaving sweet potatoes. Baking led to the most aromatic results, boiling resulted in only 54 per cent of the aroma molecules from baking and microwaving generated just 6 per cent.

SHUTTERSTOCK/PIYASET

Many of the aroma molecules in baked sweet potatoes are products of sugar caramelisation and the Maillard reaction, which occurs when sugars and amino acids are heated above 100°C (210°F) and creates the characteristic flavour of roasted and toasted foods. When sweet potatoes are boiled, the temperature doesn't get above 100°C, so this flavour development doesn't happen. The breakdown of starch into simple sugars during baking also helps by creating more substrates for these reactions, leading to a more fragrant and flavoursome result.

One advantage of baking is that heat diffuses from the outside to the inside of the tuber relatively slowly, so the flesh spends plenty of time in the temperature range where amylase enzymes are most active. When sweet potatoes are microwaved, they heat up faster and the amylase enzymes are quickly inactivated by the high temperature, giving a less sweet and less aromatic result.

A recent study considered the effects of roasting for different lengths of time at 220°C (430°F), and found that anything from 1 to 2 hours of cooking was well liked by volunteers.

Inspired by chef Lucas Sin, Tim Chin at the website Serious Eats explains how a surprising trick takes baked sweet potatoes to another level: freezing before baking. This seems to be because freezing ruptures plant cell walls. When the frozen tubers go into the oven, more water escapes from the flesh, concentrating the flavour, and sugary fluid caramelises on the outside.

To maximise amylase activity, Chin suggests baking sweet potatoes at 150°C (300°F) for 2 hours, before increasing the heat to 230°C (450°F) for 40 minutes. This might not appeal when we are all conscious of our energy usage, but in my tests, frozen sweet potatoes turned out great after baking for 1 hour at 200°C (390°F). ▮

The science of cooking appears every four weeks

Next week

Stargazing at home

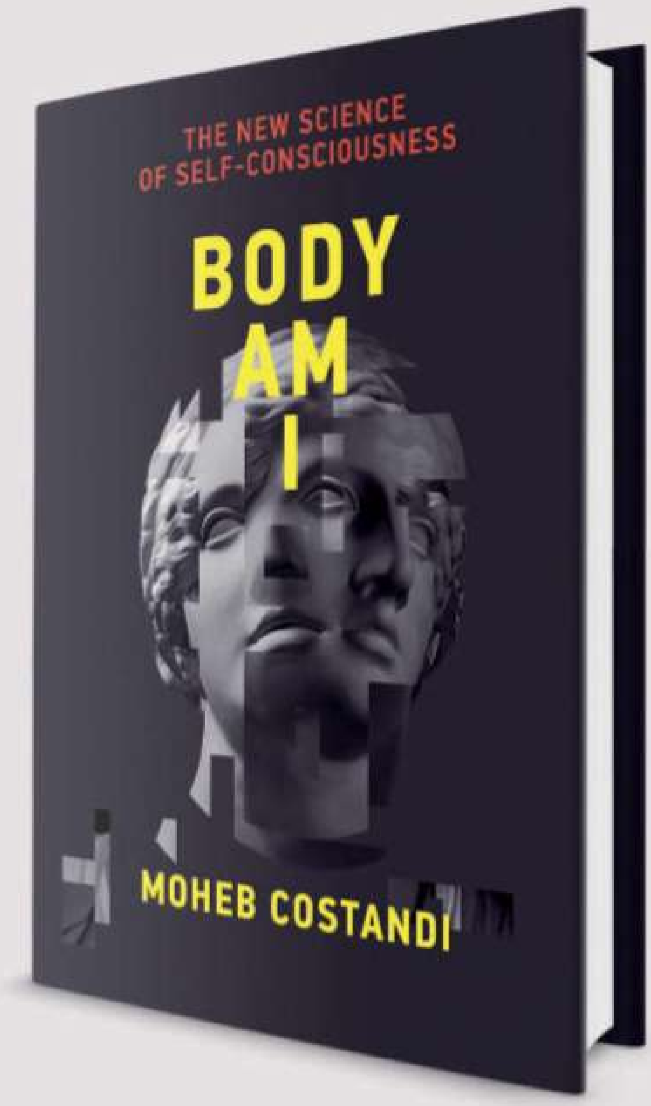
These articles are posted each week at newscientist.com/maker

SPECIAL OFFER

Give a FREE MAGAZINE to a young reader!

To give a child a
FREE PRINTED COPY
of the all new
BRITANNICA MAGAZINE,
just scan the QR code or go to
**britannicamagazine.co.uk/
free-copy**
and enter their name
and address.
No payment or ongoing
commitment required.

Conditions apply. See website for details.

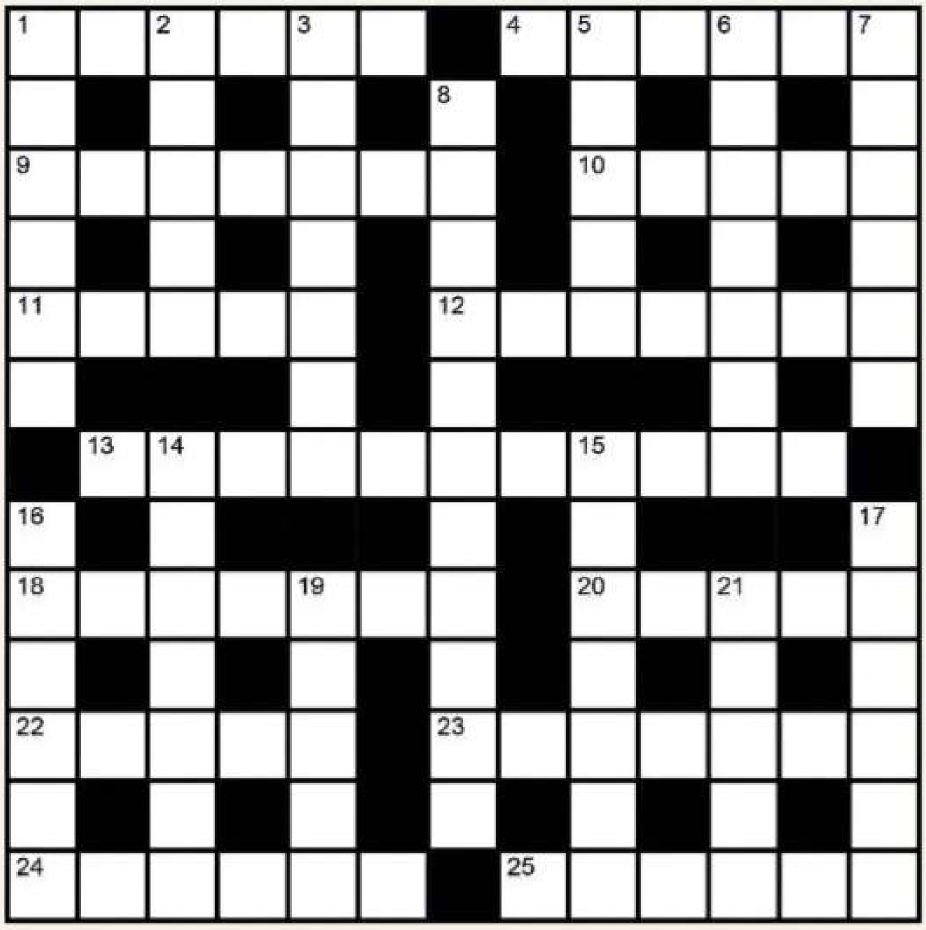


"A fascinating and mind-stretching page-turner. If you think you can understand the brain in isolation from its body, think again with Costandi's illuminating journey deep into their inseparable and curious relationship."

—David Eagleman, neuroscientist at Stanford University

Examine how the brain perceives the body, how that perception translates into our conscious experience of the body, and how that experience contributes to our sense of self. *Body Am I* explores what can happen when the mechanisms of bodily awareness are disturbed, leading to such phenomena as phantom limbs, rubber hands, and anorexia.

Cryptic crossword #95 *Set by Wingding*



Scribble zone

Answers and the next quick crossword next week

ACROSS

1 Massachusetts woman's illness (6)

4 Short reptile appears before us – a sign of spring (6)

9 One politician with every charge (7)

10 South-East Asian plant resembling insect to audience (5)

11 One leaving ball for exams (5)

12 Spots damaged section (7)

13 Stormy autumn? Thank ancient ruler (11)

18 Volatile oil near part of aeroplane (7)

20 Carnivore decapitated wizard (5)

22 Taste shown by religious leader returning after university (5)

23 Novel pie treatment for food connoisseur (7)

24 At home with bananas under control (2,4)

25 13's city is not quite number one (6)

DOWN

1 After a short time, yeti synthesised part of molecule (6)

2/16 Stone is liquid in Bolivian city, under lithium (5,6)

3 Lifeless pinniped having lost tail in salty water (4,3)

5 Grab a textile sample in north African city (5)

6 Pasadena institute expels student, first to use medicinal plant extract (7)

7 Cut around Portuguese newspaper's front page story (6)

8 Sensitive like an onion? (4-7)

14 Release two French articles on wood (7)

15 To get rid of a bad smell, linger in spa hotel to begin with (7)

16 See 2 Down

17 Underwear and cheese: extreme fragrances (6)

19 Announced wet weather rule (5)

21 Piece of scientist Humboldt's body part (5)

Our crosswords are now solvable online
newscientist.com/crosswords

Quick quiz #175

1 Which of the following isn't a trans-Neptunian object: 136472 Makemake, 486958 Arrokoth or 3451 Mentor?

2 In botany, what word is used to describe the pale bluish coating found on the surfaces of some plants, such as wine grapes?

3 Which central European anatomist is best known for his discovery of a class of large neurons that now bears his name?

4 What is the speed of sound in water?

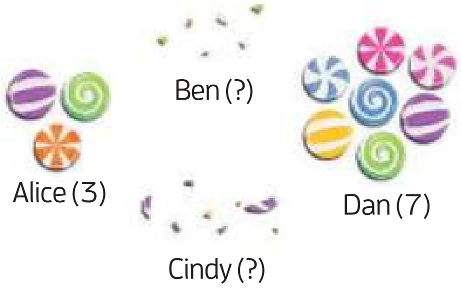
5 In what year was the Logic Theorist computer program, often known as the first artificial intelligence program, invented?

Answers on page 55

Puzzle

set by Brian Hobbs

#191 Sharing is scaring


Ben (?)
Alice (3)
Dan (7)
Cindy (?)

It is that time of year again, when the children of Shady Hollows prowl their neighbourhood threatening tricks and receiving treats.

After an evening destined to send shivers down the spine of the local dentist, four friends sit around a table comparing their haul of sugar drops. Suddenly possessed by a spirit of generosity, they each decide to give half of what they have to the friend sitting to their right (anticlockwise).

After this, each child now has more than they started with, except for one. The picture above would have shown what each child ended up with, but Ben and Cindy's sweet tooth got the better of them. How many sugar drops did Ben and Cindy each eat? Their dentist is dying to know.

Solution next week

Joe Average

Who is the average person in the world, and what is their age, location, physical appearance etc.?

Hillary Shaw
Newport, Shropshire, UK
The "average" person in the world today is male, Chinese, around 40, living near the Myanmar border, working in the service sector on $30,000 a year, with two children, living in a large city like Kunming.

However, by the mid-21st century, this person would have had to emigrate to India, maybe take a small pay cut and change sex to remain "average". The hard bit would be ageing just five years by 2050.

Jeff Dickens
Banchory, Aberdeenshire, UK
Even if we were to identify Joe Average, studies indicate that they would almost certainly not realise their averageness and may forcefully deny it.

When people are asked to rate their own abilities and performance on a whole range of topics and factors, they tend to rate themselves as above average (assuming that is the better place to be perceived to be).

"The better-than-average effect means that we all tend to rate our abilities and performance as above average"

This is so commonly observed by psychologists that it has been named the better-than-average effect. So, good luck with your attempts to wheel Joe out into the spotlight!

Albert Lewis
Toronto, Canada
I can't help much with age and location, but I have some insight on physical appearance: we are looking for someone with one breast and one testicle.

Frank Leyland
Hereford, UK
Averages can only be applied to numeric values, not anything as ill-defined as a person. The "average location" for all the world's people would be somewhere deep in Earth's core.

Pat French
Telford, Shropshire, UK
I would stay away from averages where humans are concerned. Remember that human beings have an average of less than two legs.

David Pitcher
Auckland, New Zealand
If anyone starts looking for an average person, they won't find them. This was tried in the 1940s, when US newspaper *Plain Dealer* ran a front-page story with the headline: "Are you Norma, typical woman?"

Norma was a statue on display at the Cleveland Health Museum, supposedly depicting the physique of the average woman. Her dimensions had been devised by gynaecologist Robert Dickison based on measurements of 15,000 young adult women. The newspaper was offering a prize to the real-life woman whose dimensions most closely matched those of Norma. The winner was a woman named Martha Skidmore.

But it turns out that average doesn't really exist. Not only did Skidmore's dimensions fail to match nearly half of Norma's measurements, but almost none of the contestants shared any resemblance with Norma's physique.

In the 1950s, the realisation that few people match the average dimensions led the US Air Force to develop adjustable seats for its aircraft. Cockpits designed for the average-sized pilot were the cause of many disasters.

@jeremymarchant
via Twitter
This put me in mind of a remark by stand-up comedian George Carlin: "Think about how stupid the average person is, and then realise that half of them are stupider than that."

BOY_ANUPONG/GETTY IMAGES

Does the froth of a cappuccino keep the drink warmer compared with a latte?

This week's new questions

Hot and frothy **Please help settle a friendly argument about coffee. Does a latte cool faster than a cappuccino, all else being equal (initial temperature, volume, etc.)? My friend thinks the foam on a cappuccino will insulate it better, but I reckon this effect is offset by the cappuccino having a smaller volume of hot milk.** ***David Shaw****, Thurso, Highland, UK*

Viral virtue **We hear about humans having and needing "good bacteria". Are there similarly "good viruses" in our bodies?** ***Barry Alper****, Oxford, UK*

Looking back

If the universe originated at the big bang 13 billion years ago, how can there be stars that are 30 billion light years away?

Nick Canning
Coleraine, County Londonderry, UK
Given that the universe is 13.8 billion years old, you might think the most distant observable object would be 13.8 billion light years away from us, but this isn't the case.

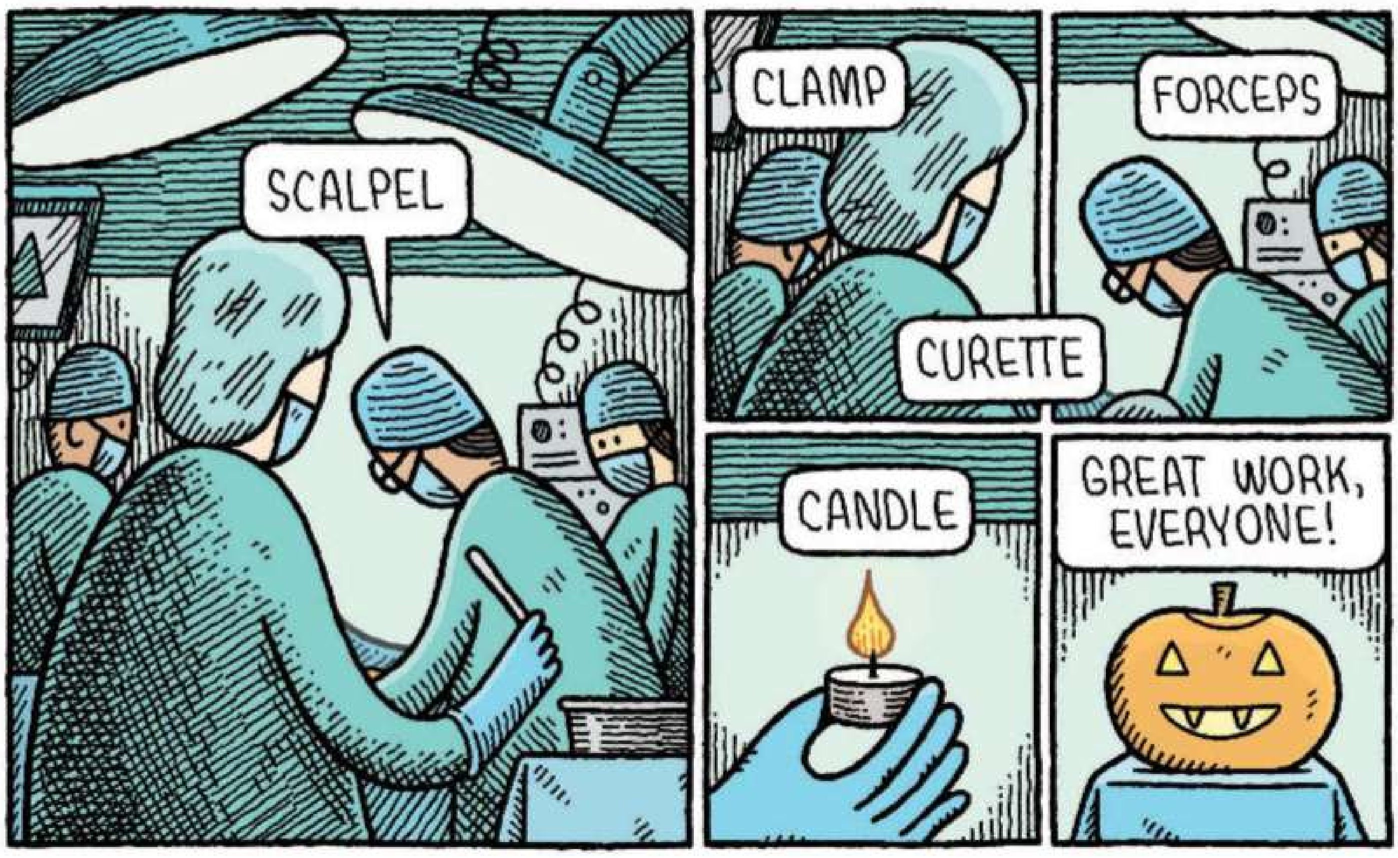
The light from the most distant object we can see (given the technology we currently have) has indeed been travelling to us for 13.8 billion years, but in that time, the expansion of the universe has increased the distance between us and that object.

The question we need to ask is: how far away is the horizon if the light has been travelling for 13.8 billion years? This is calculated using the best model we have for the history of the expansion of the universe, which shows that the horizon is 46 billion light years away from us.

Want to send us a question or answer?
Email us at lastword@newscientist.com
Questions should be about everyday science phenomena
Full terms and conditions at newscientist.com/lw-terms

Tom Gauld

for New Scientist



There may be matter beyond this horizon, but we can't detect it and it can't interact with us.

Stephen Johnson
Eugene, Oregon, US
The reason why stars can be 30 billion light years away when the universe itself is less than 14 billion years old is because of two factors.

The first is the inflation that took place immediately after the big bang, when the universe grew by 10^{26} in less than 10^{-30} seconds (yes, this is faster than the speed of light, but physics allows this since it was space-time itself that was growing, rather than objects moving away from each other).

The second factor is the continuous expansion of the universe since the end of inflation. Today, the universe is thought to be about 93 billion light years across.

From our position inside the universe, no star is 93 billion light years away from Earth, but most are more than 14 billion light years away.

> **"Light from the most distant object we can see has travelled for 13.8 billion years, but in that time, the universe has expanded"**

Danny Kermode
Vernon, British Columbia, Canada
To understand distances that span a significant portion of the known universe, it is helpful to imagine that the cosmos has only two spatial dimensions instead of three.

Think of the universe as a huge, flat sheet of rubber with only a left and right and no up and down. Even with this simplification, visualising the cosmos is still difficult.

For a start, we don't have enough evidence to conclusively identify the topology of the universe, so we can't say for certain whether our imagined sheet of rubber extends infinitely in every direction or if it loops back on itself somehow.

The universe is often depicted as having what's known as a hypersphere topology. To understand this, think of the sheet of rubber as the surface of a balloon that is inflating – this is a good way to think about the ongoing expansion of the cosmos.

Now, consider two points on the balloon's surface that are 1 billion light years apart. Picture point A sending a pulse of light that travels along the balloon's surface towards point B.

You can imagine that, depending on how fast the balloon is inflating, the pulse of light might never even reach point B. Let's say that it takes 10 billion years for the pulse to arrive at point B. When it arrives, how far apart are points A and B?

Hopefully, it now makes sense that points A and B will be more than 10 billion light years apart. What's more, depending on the rate of inflation, even though the universe may have started inflating from a single point 13 billion years ago, points A and B may now be 30 billion light years apart. ▮

Answers

Quick quiz #175 *Answers*

1 3451 Mentor, which trails in Jupiter's orbit around the sun
2 Glaucous
3 Jan Evangelista Purkinje
4 1481 metres per second
5 1956

Quick crossword #119 *Answers*

ACROSS 1 Up-to-the-minute, **10** Beebe, **11** Zinc oxide, **12** Varicella, **13** Enema, **14** Silicon, **16** Existed, **18** Albidus, **20** Extinct, **22** *E. coli*, **24** Ballistic, **26** Euclidean, **27** In ovo, **28** Pitch darkness

DOWN 2 Pleural, **3** Oleic acid, **4** Hazel, **5** Manganese, **6** Noose, **7** Trident, **8** Above sea level, **9** Metal detector, **15** Nosebleed, **17** Intuition, **19** Bronchi, **21** Nitrous, **23** Iliac, **25** Lunar

#190 All square *Solution*

1-6 6-4 6-4 (giving the number 166464, which is 408^2). Square numbers all end in 1, 4, 6, 9, 25 or 00, but ?9/25/00 aren't tennis set scores, so the last set was 6-1, 6-4, or ?-6. If the winner won the first set, possible scores are limited to just two ranges, 606760 to 646776, and 750660 to 766776 (squares of numbers between 775 and 875). If the loser won the first set, the number is a six-digit square that begins 16, 26, 36, 46, 57 or 67. The only square numbers with the right format for tennis sets are 166464, 633616 and 646416, but 633616 breaks the rule about the winner's games being given first, while 646416 wouldn't go to a third set.

Holy nitpicking

Nitpicking often draws criticism, but Gérard Lucotte, Areki Izri and Thierry Thomasset didn't let that deter them from publishing their sixth article in a series of keen looks at some old hairs. It is called "Nits of louse on the hairs of Holy Maria-Magdalena: A SEM-EDX study".

Lest there be confusion, let's be specific about the hairs. The study says they come from "a large lock" of Mary Magdalene's hair that was "arranged in a dedicated reliquary" in the basilica of the village of Saint-Maximin-la-Sainte-Baume in southern France. The authors go on to explain that Mary Magdalene is "the most abundantly cited women [sic] of the four Gospels".

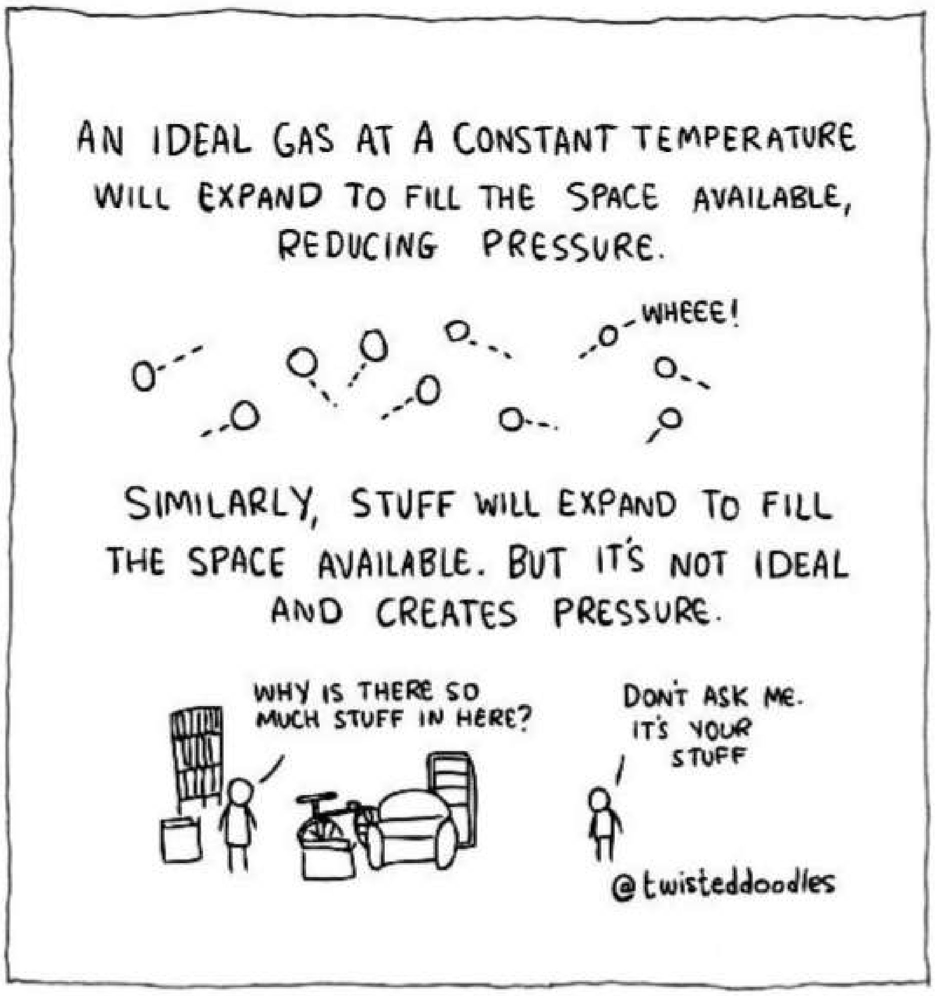
Lucotte, Izri and Thomasset perused 10 hairs in two ways: with scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX). In slightly plainer words, they made microscopic examinations and did chemical analysis.

The writing in the paper is sometimes evocative, as in this passage: "Figure 4 shows a bulging nit adhering to the hair number 7 surface." And the final paragraph conveys, perhaps, hints of suppressed emotion at the keyboard: "Given the great oldness of Maria-Magdalena's remains, at one period where hygiene habits were not so drastic as today, it is not so surprising that the hairs of Holy Maria-Magdalena would be massively infested by snits [sic] of loose [sic]".

The team's previous studies of these historic hairs present "observations of fennel rests, marine micro-remains, silver and gold particles, skin debris and mineral particles deposited on the hair surfaces". (Fennel rests are described as "pollen grains, leaf and stem debris".)

The nits of louse study was published in *Global Dermatology*. On its website, the journal invests the citations of its articles with an easy-to-remember acronym: Global Dermatology (GOD).

Twisteddoodles *for New Scientist*


AN IDEAL GAS AT A CONSTANT TEMPERATURE WILL EXPAND TO FILL THE SPACE AVAILABLE, REDUCING PRESSURE.
WHEEE!
SIMILARLY, STUFF WILL EXPAND TO FILL THE SPACE AVAILABLE. BUT IT'S NOT IDEAL AND CREATES PRESSURE.
WHY IS THERE SO MUCH STUFF IN HERE?
DON'T ASK ME. IT'S YOUR STUFF
@twisteddoodles

Got a story for Feedback?

Send it to feedback@newscientist.com or New Scientist, Northcliffe House, 2 Derry Street, London W8 5TT

Consideration of items sent in the post will be delayed

Quantum spirituality

Feedback was amused that the person who has best demonstrated that quantum is valuable – that the word "quantum" has measurable financial worth – went unmentioned when this year's Nobel prize in physics was announced to honour research that tested the reality of quantum entanglement.

Deepak Chopra has spent decades entangling the word quantum into public discussions of spirituality, happiness and success. But it will be three physics professors who will shake a royal hand in Stockholm this December. Those whose understanding of "quantum" comes from Chopra can but wonder.

Chopra is a masterful writer. His prose can suggest every possible meaning, simultaneously. See for yourself. Read aloud these two examples: "The limitations of physical life count for much less in the quantum world, and often for nothing"; "The mind replenishes itself in silence, the quantum source for all activity."

Those quantum-centric sentences are the quantum heart of Deepak Chopra's 1993 master quantum work, *Ageless Body, Timeless Mind*, one edition of which labels itself *The quantum alternative to growing old*.

In 1998, physicist Roy Glauber, in a ceremony at Harvard University, gave this brief speech in tribute to Chopra: "There is not much that I need to tell you about relativistic quantum mechanics... Its achievements in the world of atoms and particles have been great. Its successes, on the other hand, in the world of psychiatry and emotional well-being have been few. And it has certainly not been known for them, particularly. Not, that is, until the recent work of tonight's honoree."

The occasion? The awarding of that year's Ig Nobel physics prize to Chopra. Seven years later, the King of Sweden presented Glauber with a Nobel prize in physics for his "contribution to the quantum theory of optical coherence".

Vulvas for Dummies

Matthew J. Zdilla suggested that Feedback take a look at his report called "What is a vulva?", published recently in the journal *Anatomical Science International*.

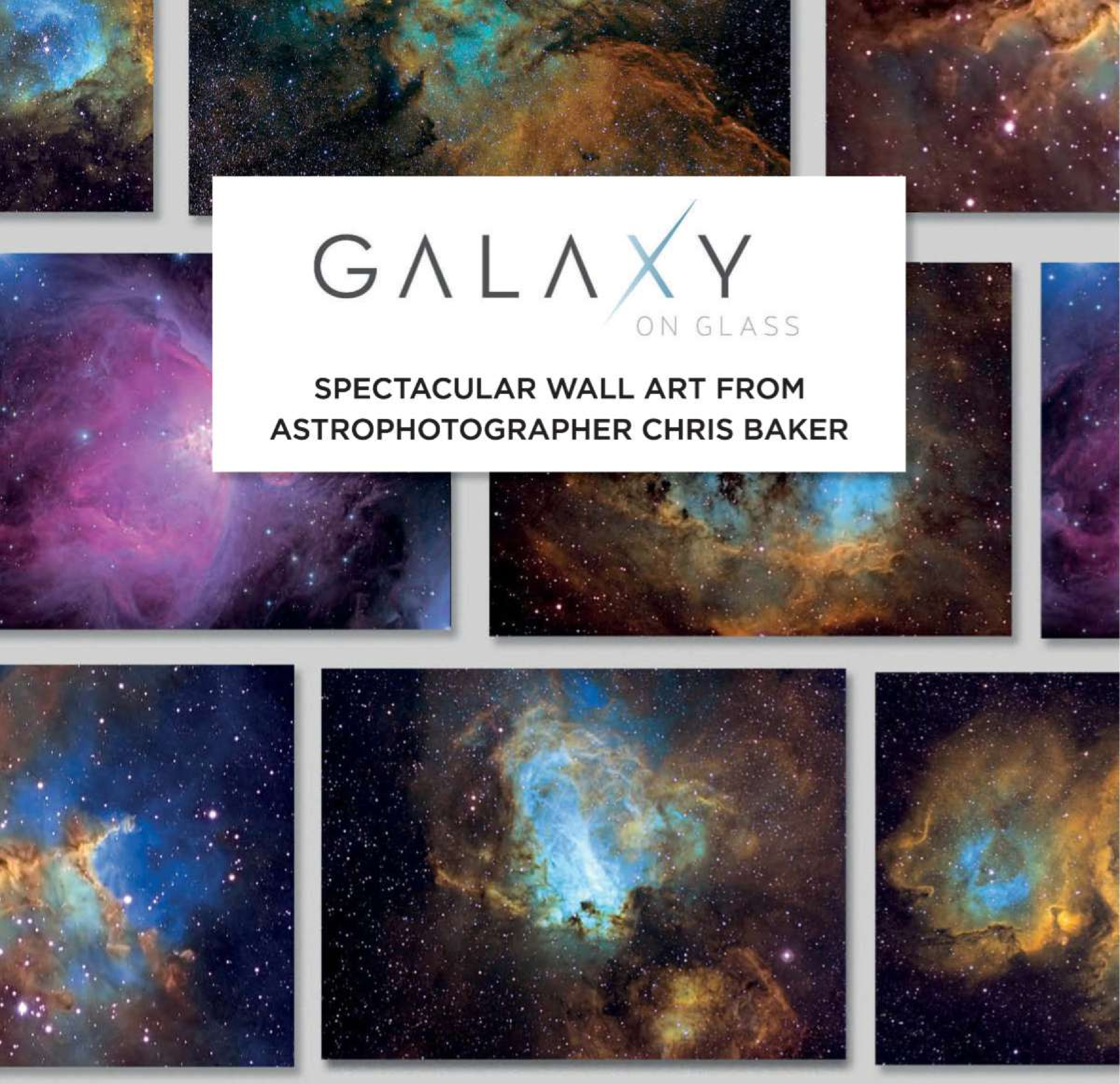
The article contains many things of interest to vulva scholars and newbies alike. The first nine words give an excellent summary of the entire 24-page-long paper: "What exactly is a vulva? The question remains unresolved."

The "What is a...?" format for titles is reminiscent of the "... for Dummies" format that has had a long, lucrative run in the publishing industry. The potential reader perceives a promise of gentle clarity, rather than one of overwhelming abstruseness.

Scholarly journals have given the world thousands of reports that sport titles beginning with "What is a...". Let's peek at a few. Helen Steward wrote "What is a continuant?", which opens: "In this book, I explore the question [of] what a continuant is, in the context of a very interesting suggestion recently made by Rowland Stout, as part of his attempt to develop a coherent ontology of processes." "What is a continuant?" appears in volume 89 of a journal called *Aristotelian Society Supplementary Volume*.

Miha Kovač and his colleagues wrote a paper called "What is a book?" It begins: "The aim of this paper is to reach a level of conceptual clarity about what we call a book." You might also delight in "What is a slur?", "What is a question?", "What is an answer?" and "What is an answer? That is the question". ▮

Marc Abrahams



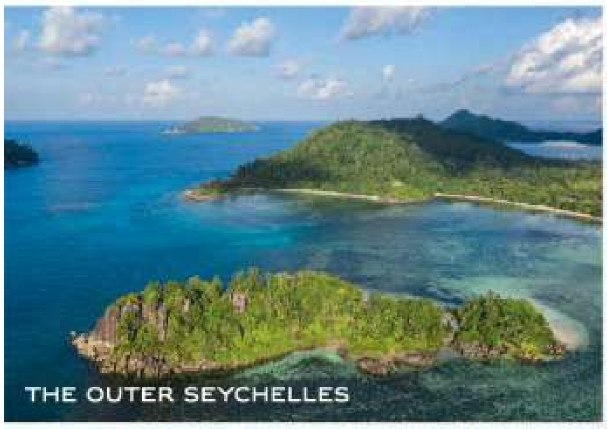
GALAXY
ON GLASS

SPECTACULAR WALL ART FROM
ASTROPHOTOGRAPHER CHRIS BAKER

NEW SCIENTIST LIVE

Thank you to all those who visited my stand. All of the pictures exhibited at the show are now available in a new Gallery Sale. See website for details.

www.galaxyonglass.com
chris@galaxyonglass.com | +44 (0)7814 181647


THE OUTER SEYCHELLES

AZORES ARCHIPELAGO, PORTUGAL

FLORIDA GULF COASTLINE, UNITED STATES

SYLVIA EARLE EXPLORES COCOS ISLAND, COSTA RICA

THERE ARE OVER 130 HOPE SPOTS GLOBALLY

SYLVIA EARLE WITH VOLUNTEERS, THE OUTER SEYCHELLES

GREAT BARRIER REEF, AUSTRALIA

MOBULA RAYS, AZORES ARCHIPELAGO, PORTUGAL

SEA LION, GALAPAGOS, ECUADOR

ON OUR WATCH

Hope can now be spotted across all our planet's seas and oceans. Sites are made into aquatic havens by local communities, to safeguard the richness and diversity of the ecosystems they depend on. Sylvia Earle's invaluable experience as an explorer and marine biologist continues to help further their goal, through her organisation, Mission Blue. Together, they have created over 130 Hope Spots and counting. Carrying a message of hope for generations to come. It is that vision, that dedication to a perpetual planet, which we are proud to stand by. **For as long as it is needed.**

#Perpetual

OYSTER PERPETUAL ROLEX DEEPSEA

MISSION BLUE

ROLEX SUPPORTS MISSION BLUE
IN ITS COMMITMENT TO PROTECTING
30% OF THE OCEANS BY 2030

ROLEX